United States
Department of
Agriculture

**Forest
Service**

Pacific
Northwest
Region

February 2010

Environmental Assessment for South Fork Skokomish Large Wood Enhancement Project

Olympic National Forest

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CHAPTER 1 – PURPOSE AND NEED

Introduction

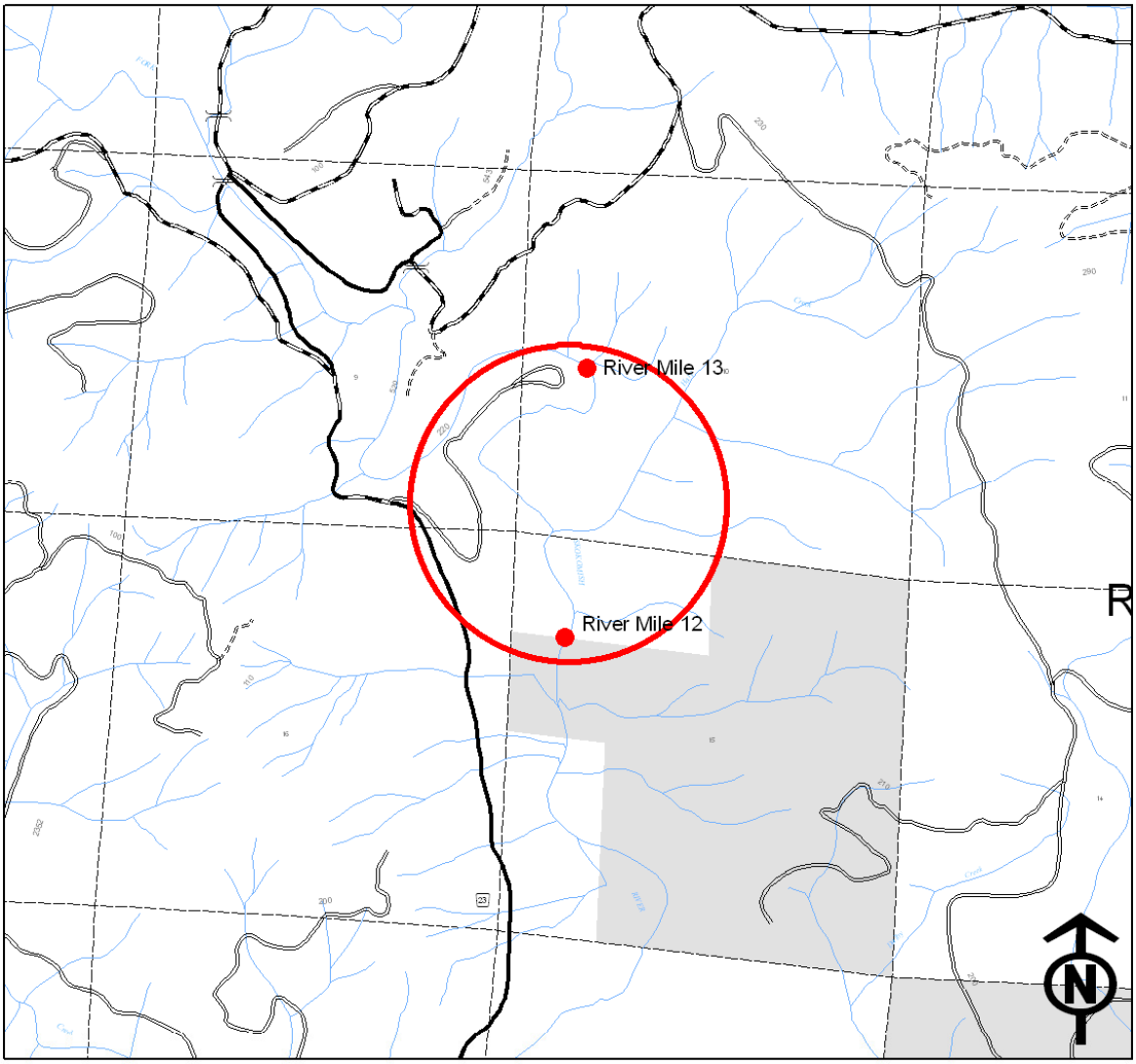
The Olympic National Forest has prepared this Environmental Assessment (EA) in compliance with the National Environmental Policy Act (NEPA) and its implementing regulations at 40 CFR 1500-1508. It analyzes the effects of the various actions described in the Proposed Action for the South Fork Skokomish Large Wood Enhancement project.

The Forest Service rule (36 CFR 220) that regulates the content and preparation of EAs was adopted on July 24, 2008. Under this rule there may be only one action alternative. Alternatives, including the Proposed Action, may be modified during the analysis process, provided the modifications are documented. Under the 2008 rule EAs must be concise and primarily serve as a basis for determining whether or not there are any effects that would require the preparation of an Environmental Impact Statement (EIS). As further specified in the Forest Service Handbook (1909.15, Chapter 40) the length and detail of an EA may vary; however, it should be brief and concise and not normally exceed 15 pages. This EA will adhere to the new rule and Forest Service Handbook direction and may appear different from EAs the Forest has published in the past.

Project Location

This action would occur within the South Fork Skokomish River and North Fork Skokomish River (both 5th Field HUC watersheds) in Mason County. The legal description is: T22N, R5W, Sections 9-10, 14-16 and 24. The primary wood source (Units 1, 4, and 9) is within the North Fork Skokomish watershed. An additional wood source (Unit 3) is located in the South Fork Skokomish watershed. The proposed large wood complexes would be constructed within a one mile segment of mainstem South Fork Skokomish River that spans Rivermile (RM) 12 to 13.

Map 1. Project Location



South Fork Skokomish Large Wood Project

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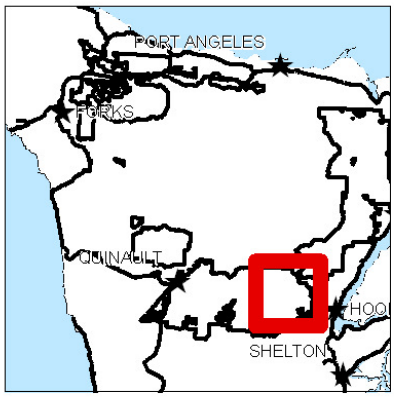
Legend

Project Area

Private Land

USDA FOREST SERVICE
OLYMPIC NATIONAL FOREST



Background

The Skokomish basin is located in the southeast corner of the Olympic Peninsula in Washington State. The Skokomish River and its two main tributaries, the North Fork Skokomish and South Fork Skokomish rivers, drain a watershed of approximately 240 square miles. The ownership of the Skokomish basin consists of 50 percent Olympic National Forest, 18 percent Olympic National Park, 15 percent Green Diamond Resource Company, 6 percent private, 6 percent City of Tacoma, 3 percent State of Washington, and 2 percent Skokomish Tribe. The higher elevation lands are primarily federal ownership, while the lower elevation lands of the Skokomish basin are primarily tribal reservation and private farmlands.

The construction of upper and lower Cushman Dams in the 1920s diverted approximately 40 percent of the Skokomish River flow directly into Hood Canal. Logging progressed up the valley and into the tributaries by the 1940s. By the early 1990s an estimated 80 percent of the South Fork Skokomish watershed had been logged and hundreds of miles of timber harvest-related road had been constructed. Other land management practices that have influenced the Skokomish River are gravel mining, channel straightening, and river berm and dike construction. Flooding and apparent changes in the water table in the lower valley have become a significant issue to landowners and the local agriculture community.

The South Fork Skokomish composes approximately one-third of the watershed area (80 square miles). Significant in-stream large woody debris (LWD) removal occurred from 1940 -1960. In 1952, a dam was proposed for the South Fork Skokomish at the downstream end of the analysis area. The area above the proposed dam was logged and large wood within the stream was removed. Due to geologic concerns of fault lines, the dam project was canceled.

With the establishment of the Olympic National Forest Land and Resource Management Plan in the 1990s the management focus of Forest Service land in the Skokomish basin shifted from intensive timber harvest and road construction to restoration.

The Skokomish Tribal Nation and the Hood Canal Coordinating Council have been partners since the early planning stages of this proposed project. The project has benefited from a strong collaborative effort through project development and refinement, and the identification and pursuit of diverse funding sources.

Purpose and Need

The purpose of this project is to improve watershed conditions in the South Fork Skokomish Watershed using management actions that are consistent with direction in the Olympic National Forest Land and Resource Management Plan (Forest Plan) and the South Fork Skokomish Watershed Analysis.

There is a need for action to stabilize the river channel and increase habitat complexity through the installation of LW complexes in the Lower South Fork Skokomish River from approximately River Mile (RM) 12 to 13.

Fish habitat in the upper South Fork Skokomish River is in a degraded condition due to past management activities. The inundation area above the proposed dam was logged and large wood within the stream was removed, approximately from river mile 11 to 14. Additionally by the early 1990's an estimated 80% of the South Fork Skokomish watershed had been logged and an extensive road network had been constructed.

Currently there are three federally listed threatened fish species in the upper South Fork Skokomish River, Puget Sound steelhead, Puget Sound Chinook, and bull trout. The Skokomish Tribe has started to reintroduce Puget Sound Chinook, listed as threatened, to the upper anadromous reach of the watershed, as outlined in the draft Chinook Recovery Plan. Improving fish habitat within the proposed treatment reach will aid in the success of the Chinook reintroduction effort.

A geomorphic and fish habitat survey has identified the need for large scale restorative work within the mainstem from RM 10.8 to 12.9 and floodplain of the South Fork Skokomish River (USDA TEAMS 2008). The purpose of this project is to stabilize the river channel and increase fish habitat complexity through the installation of LW complexes. These restoration activities would improve habitat conditions for the listed fish in the upper watershed, and further the recovery efforts as identified in the draft Recovery Plans for both Chinook and bull trout. Additionally, the use of large wood to improve fish habitat in the upper watershed as a restorative step has been identified in the South Fork Skokomish Watershed Analysis 1995, and the Hood Canal Coordinating Council Three-Year Watershed Implementation Priorities. The Skokomish Watershed Action Team (SWAT), a partnership group interested in restoring the Skokomish River composed a three year action plan in 2007. One of the action items is in-stream and riparian habitat enhancement through in-stream large wood placement.

If no action is taken the stream channel, riparian vegetation, and fish habitat would remain in their current degraded conditions for the foreseeable future. Due to the lack of LW and inadequate riparian vegetation, streambank and terrace erosion rates within the project area would remain high and continue to produce and deliver sediment to the downstream reaches of the South Fork and main stem Skokomish River. Large wood levels would remain low within the project area until upstream riparian stands mature and are able to contribute adequate size classes (expected to require 30 years or more). Riparian vegetation within the unstable floodplain will continue to be washed away and reset every 5 to15 years until adequate LW is recruited and deposited on the floodplains and bankfull perimeter to create stable jams and structures. Wide shallow and simplified stream channel conditions will persist; organic/nutrient retention and fish habitat complexity such as deep pools and hiding cover will remain limited.

Summary of Proposed Action

The proposed floodplain and river restoration work would extend from approximately RM 12 to 13, and would be designed to accelerate the recovery of channel processes, riparian conditions, and fish habitat. The project area would be on National Forest ownership. The project would include:

- Construction of approximately 30 strategically placed log jams and LW structures along the edges of the main channel, on the flood plain, and at tributary outlets.
- Heavy equipment access trails would be created as necessary to provide access to structure locations.
- Restoration of approximately 12 acres of new stable protected floodplain areas above the bankfull elevation using tree and shrub species (cottonwood, willow, alder, and conifers) to increase floodplain roughness, capture fine sediment, increase bank and terrace stability, and provide stream shade.
- Removing approximately 2,700 trees from nearby second-growth timber stands in order to provide the necessary large wood for the project.
- Utilizing helicopters to transport the trees from the timber stands to the river bank along the SF Skokomish River.
- Reconstructing and decommissioning approximately 0.5 mile of a closed and abandoned forest road to provide access for heavy equipment and maintenance vehicles from the Oxbow Campground to the project site.

The Proposed Action has been slightly modified from the version described in the February 2, 2009 scoping letter. Changes resulted from additional field reconnaissance and public input. These changes are discussed under the alternatives eliminated from further analysis section.

Decision to be Made

The Responsible Official for this project, the Hood Canal District Ranger, will decide:

- The extent of restoration actions within the mainstem and floodplain of the South Fork Skokomish River.
- The location of stands to be used as wood sources.
- Mitigation measures that would apply to the action.

Management Direction

This EA is tiered to the Olympic National Forest Land and Resource Management Plan Final Environmental Impact Statement (FEIS) and Record of Decision (ROD), as amended. A major amendment includes the FSEIS on the Management of Habitat of Late-Successional and Old-Growth Related Species Within the Range of the Northern Spotted Owl, as adopted and modified by the April 1994 Record of Decision (commonly known as the Northwest Forest Plan). It also tiers to the Pacific Northwest Region Invasive Plant Program Preventing and Managing Invasive Plants FEIS and ROD, as well as the Olympic National Forest Beyond Prevention: Site-Specific Invasive Plant Treatment Project FEIS and ROD.

This EA incorporates by reference the following documents:

- Olympic National Forest Land and Resource Management Plan (Forest Plan).
- South Fork Skokomish Watershed Analysis and Restoration Summary.

The Northwest Forest Plan-designated land allocations within the project area are Late-Successional Reserve (LSR), Adaptive Management Area (AMA), and Riparian Reserve (RR). The objective of LSR lands is to protect and enhance conditions of late-successional and old-growth forest ecosystems. AMAs were designated to encourage the testing of innovative approaches to integrating ecological, economic and other social and community objectives. Riparian Reserves, overlaying other Northwest Forest Plan land allocations, are intended to protect the health of the riparian and aquatic system. This project would help meet the objectives of these allocations by improving overall watershed conditions.

Public Involvement

Scoping for this project was initiated on January 1, 2007 by listing this project in the Forest's Schedule of Proposed Actions (SOPA). Scoping with the Skokomish Tribe officially began with a scoping letter on February 2, 2009. Scoping letters were sent to the general public on February 2, 2009. These letters announced the availability of the Proposed Action and the opportunity to respond to the proposal. Additional scoping occurred with public meetings sponsored by the Skokomish Watershed Action Team (SWAT) on February 11, 2009 and two field trips one to look at the wood source units (April 17, 2009) and the other to see proposed LW structure location (November 2, 2009).

The Forest received six responses from organizations and individuals from the scoping process. Four of the responses were favorable and showed support for the project, one response had no comments, and one response opposed the project due to costs and structure design. These responses were considered in the development of the current Proposed Action and in the development of this environmental analysis.

Issues

Scoping responses and internal discussions were used to identify issues. The issues were reviewed and categorized by the interdisciplinary team and Responsible Official. Two categories of issues were identified: Other Issues and Issues Raised but Dropped from Further Analysis. Many projects have a third issue category, Key Issues, but this category was not applicable to this project. Key Issues are used to formulate or drive alternatives. No Key Issues were identified for this project.

Other Issues

These are issues that have been determined to be relevant, are used to disclose consequences, may affect project design or prescribe mitigation measures, or whose disclosure of environmental effects are required by law or policy.

- **Fish Habitat**
  There are three federally listed threatened fish species in the upper South Fork Skokomish River. No action will maintain degraded channel conditions and degraded river and riparian habitat for fish. The proposed action combined with other restoration activities

within the South Fork Skokomish watershed, over time will cumulatively improve fish habitat conditions.

- **Structure Stability**
  One of the issues raised in scoping comments was concern of structural stability of the large wood structures during 100 year flood events in the South Fork Skokomish.

- **Wood Source**
  Approximately 2,700 whole trees would be needed to provide the necessary large woody material for the project. Trees ranging from 6 to 30 inches in diameter would be removed from about 17 acres in gap openings within 115 acres of second-growth forest stands in the North Fork and South Fork Skokomish subwatersheds.

- **Invasive Plants**
  Under the proposed action, there would be ground disturbance and newly exposed soil. These areas would be susceptible to invasive plant colonization.

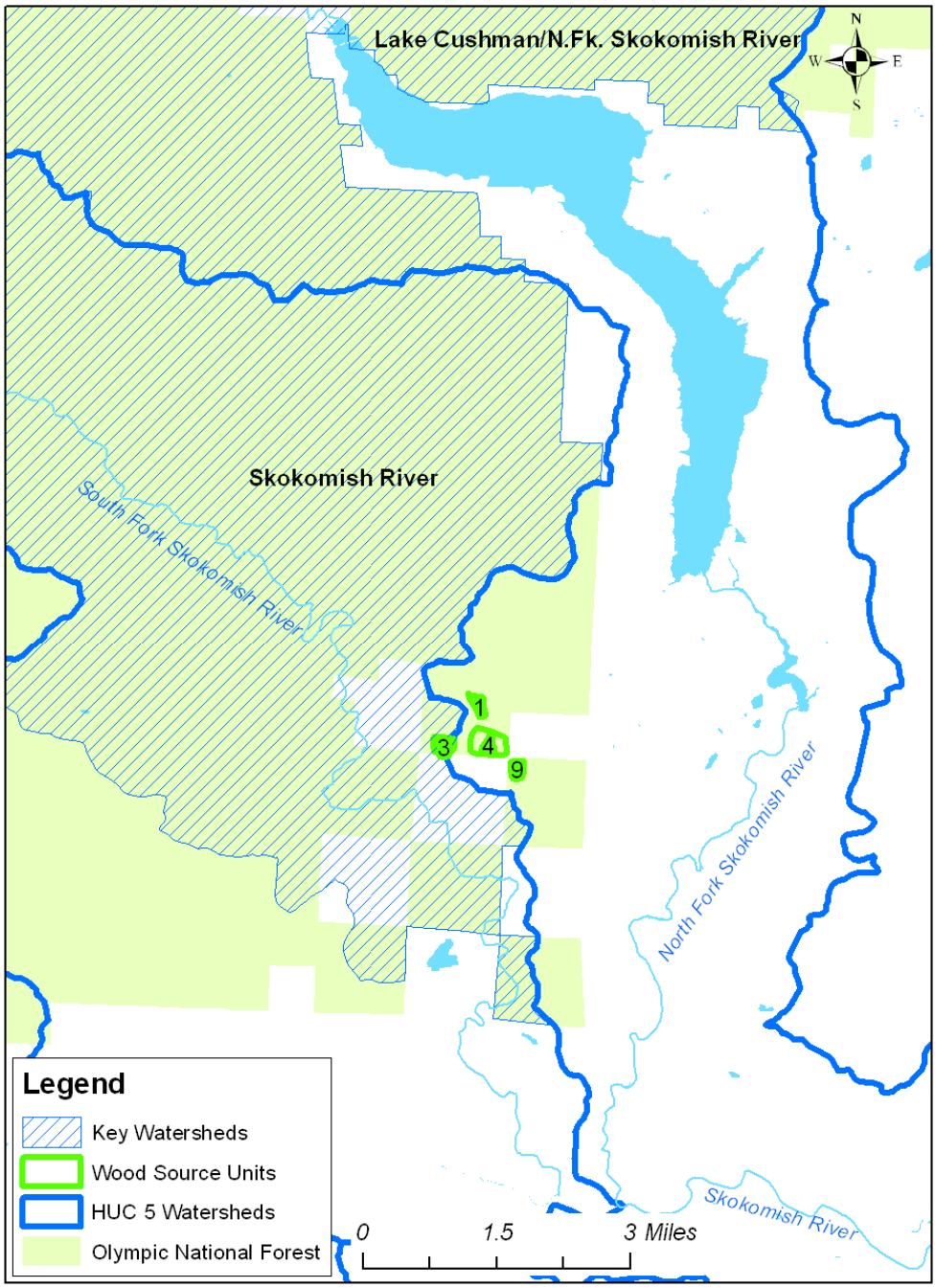
- **Recreation**
  One of the issues raised in scoping comments was the potential for the in-stream structures to create safety hazards for river users.

Issues Raised but Dropped from Further Analysis

The following issues were identified but dropped from further analysis associated with the Proposed Action as they have been addressed through project design or already considered in a separate planning effort.

It was originally stated in the Scoping Letter that tree removal as a wood source for the in-stream structures would occur in a Key Watershed. Upon further analysis of Key Watershed designation Olympic National Forest and the Region 6 Regional Office determined that the portion of the North Fork Skokomish that the analysis would occur is not designated a Key Watershed in the Forest Plan. The portion of the North Fork Skokomish which is designated as a Key Watershed ends at the reservoir (Lake Cushman). According to the Northwest Forest Plan designation of Key Watersheds the portion of the North Fork Skokomish where project activity would occur is not designated as a Key Watershed, which is well below the reservoir (Lake Cushman) on the North Fork Skokomish River.

It was originally stated in the Scoping Letter that 135 acres of units used for tree removal as a wood source for the in-stream structures would occur in land designated LSR (Late Succesional Reserve). The units selected were changed to focus all timber removal activity to AMA (Active Management Areas). The units where timber removal would occur consist of approximately 115 acres of lands designated AMA.


Lake Cushman/N.Fk. Skokomish River
N
W
E
S
Skokomish River
South Fork Skokomish River
North Fork Skokomish River
Skokomish River
1
3
4
9
Legend
Key Watersheds
Wood Source Units
HUC 5 Watersheds
Olympic National Forest
0
1.5
3 Miles

CHAPTER 2 – ALTERNATIVES

Introduction

This section describes the alternatives considered in detail and a summary of project design criteria, measures to mitigate environmental effects, and monitoring. The section concludes with a summary and comparison of the alternatives.

Alternatives Considered but Eliminated from Further Analysis

The following alternatives have been eliminated from detailed study for the stated reasons.

The original project consisted of two phases. Phase 1 is entirely on Olympic National Forest land and it is the action being analyzed in this environmental assessment. Phase 2 consists of similar actions but is located downstream off of Forest Service lands. Only Phase 1, the upstream portion of the project, will be analyzed in this Environmental Assessment. Planning for Phase 2, the downstream portion will be pursued at a future time pending available funding.

Utilizing log trucks for ground based tree removal to transport the large wood material from the source areas to the in-stream structure project area rather than helicopters was initially considered but was dropped from further consideration. This alternative would have required extensive reconstruction of several miles of old roads that have been previously decommissioned or abandoned and some construction of new roads in riparian areas to access the river channel. Reconstructing the old roads to a standard that would allow for haul and then decommissioning them after they were no longer needed. This action would have cost as much or more than a helicopter and would have caused many more adverse resource impacts.

Alternatives Considered in Detail

Two alternatives, including the No Action Alternative, are analyzed in detail. The No Action Alternative provides a basic description of conditions against which the Proposed Action is compared. Since no Key Issues were identified for this project, no alternatives to the Proposed Action were developed. As discussed in this document's introduction in Chapter 1 this is acceptable under Forest Service NEPA regulations.

No Action Alternative

Under the No Action Alternative no management actions included in the Proposed Action would be implemented. No construction of log jams and LW structures would occur, no removal of timber for these in-stream structures would occur, no road reconstructing and decommissioning

would occur, and no floodplain restoration would occur. This alternative would not meet the Purpose and Need of the project.

Proposed Action Alternative

The proposed floodplain and river restoration work would extend from approximately RM 12 to 13, and would be designed to accelerate the recovery of channel processes, riparian conditions, and fish habitat. The project area would be on National Forest ownership. The project would include:

- Knocking down and removing approximately 2,700 trees from about 17 acres in gaps openings within 115 acres of nearby second-growth timber stands with large excavators, in order to provide the necessary large wood for the project. Majority of trees will have rootwads attached. No new roads would be constructed.

- Reconstructing and decommissioning approximately 0.5 mile of a closed and abandoned forest road to provide access for heavy equipment and maintenance vehicles from the Oxbow campground to the project site.

- Utilizing helicopters to transport the trees from the timber stands to the river bank along the SF Skokomish River.

- Construction of approximately 30 strategically placed log jams and LW structures along the edges of the main channel, on the flood plain, and at tributary outlets.

- Heavy equipment access trails would be created as necessary to provide access to structure locations.

- Restoration of approximately 12 acres of new stable protected floodplain areas above the bankfull elevation using tree and shrub species (cottonwood, willow, alder, and conifers) to increase floodplain roughness, capture fine sediment, increase bank and terrace stability, and provide stream shade.

Project Design Criteria and Mitigation Measures

Wildlife:

- Any tree >21" dbh with limbs greater than 4" in diameter that have wide bare branch, moss or lichen-covered branch, mistletoe brooms or other deformaties, and are at least 33feet high in the live crown of a coniferous will receive a 100 feet no-treatment buffer.

- Noise generating activities (>92 db) that occur within harassment distance to suitable murrelet habitat (for the type of equipment used) between April 1 and September 15 that involve the use of heavy equipment and chainsaws must begin no earlier than 2 hours

after sunrise and must stop 2 hours before sunset to minimize effects to murrelets delivering food to their young.

- Danger tree mitigation that includes the dropping of a tree at least 21 inches dbh within suitable marbled murrelet or suitable spotted owl habitat during the early murrelet breeding season (April 1—August 5) or early spotted owl breeding season (March 1—July 15) will require review by a Forest Service Wildlife Biologist.

- Employees and contractors will properly store and dispose of food and garbage while working on-site to avoid attracting corvids to reduce indirect impacts to murrelets and other wildlife.

- Long-duration motorized & mechanized activities would not be permitted to occur within 0.25 mile of known, active fisher denning sites between March 15 and May 31 in order to minimize disturbance effects. Seasonal restrictions would not be applied for general road traffic. Adjustments for the buffer would be based on local conditions such as topography.

- Avoid placing gaps near snags. Any snags 16 inches dbh or greater will be given a no-cut buffer, which is at a minimum equal to the snag height.

- Wherever possible, the native plants species used to revegetate decommissioned road surfaces should include those with value to wildlife species.

Invasive Plant Prevention and Management:

- Treat existing invasive plant infestations with appropriate herbicide, mechanical, or manual methods before ground disturbing activities begin when practical. If timing or resources prevent treatment before the project begins, then treat infestations in the project area upon completion of the project in order to prevent invasive plants from colonizing the disturbed ground.

- Clean all off-road equipment of dirt/mud, seeds, and other plant parts before it is moved onto National Forest Service land. If operating in an area infested with invasive plants, clean all equipment before moving between sites or leaving the project area. For cleaning equipment on Forest Service land, the Contractor and Forest Service shall agree on methods of cleaning, locations of the cleaning, and control of off-site impacts, if any. **'**Off-road equipment' includes all machinery other than log trucks, chip vans, pickup trucks or vehicles used to transport personnel on a daily basis.

- All material (e.g. soil, gravel, sand borrow, aggregate, etc.) transported onto National Forest System land or incorporated into the work shall be weed-free.

- Erosion control and weed prevention measures, such as seeding and mulching, will be implemented as necessary on disturbed soils as soon as possible after operations are

complete Mulch used on the project shall be weed-free. Seed used in the project shall be weed-free and meet state and local noxious weed laws.

Botany:

- Maintain a 150 foot radius no-removal buffer around the occurrence of the sensitive lichen, *Usnea longissima* along the 2340-310 spur (decommissioned road that accesses unit 4).

- Minimize damage or removal to red alder or big leaf maple 12" DBH or greater.

Revegetation:

- Use native species for revegetation where feasible. Give priority to seed mixes and plantings originating from local, genetically appropriate stock. Refer to the Focus List for Olympic National Forest for guidelines.

- A revegetation plan will be prepared by the USFS. Plant communities in disturbed riparian areas, temporary access roads, and newly protected stable floodplains would all be restored to native vegetation after logjam construction is completed. Passive restoration would be utilized where seed source and site conditions are favorable for germination and establishment of desired species. Active restoration using native plant species from local genetic stocks would be utilized in areas where conditions for passive restoration are not favorable. After trees are removed from the AMA units western white pine would be planted.

Erosion, Water Quality and Sediment Prevention:

- Regular hydraulic fluids of heavy equipment (excavators) used for in-stream construction will be replaced with pollution control hydraulic fluid.

- Maintain a minimum of a 200 foot no-cut buffer around the wetland in Unit 3

- A written erosion and sedimentation prevention and containment plan for the project will be prepared and all necessary personnel, supplies, and equipment will be available to implement the plan promptly and effectively.

- Boundaries of gaps and new equipment access trails (if necessary) will be flagged to delineate clearing limits associated with site access, skid trails, gap openings. This will minimize overall disturbance and disturbance to critical vegetation and sensitive areas.

- Staging area (Oxbow campground) will be established on existing roadways for heavy equipment storage, vehicle storage, fueling, servicing, and other equipment usage needs. Staging areas will be located beyond the 100-year flood- prone area in a location and manner that will preclude erosion into or contamination of the stream or floodplain.

Equipment Access Trails:

- New designated equipment access trails will be flagged.

- Ground-based machinery will stay within designated areas in order to minimize the amount of area in a detrimental soil condition, and not exceed the 20% Regional Soil Quality Standard. Equipment disturbance will primarily be confined within gap openings (1 to 1.5 ac), and also on existing skid trails, landings and old road grades.

- Equipment operations shall occur during the dry season (June through September) when soil moisture conditions are more suited for this activity. If wet soil conditions exist at time of operations, equipment should be re-located to more suitable activity area, or operations temporarily suspended until conditions improve.

- Tree removal priority within units should be adjacent to existing skid trails, landings and unclassified/previously-decommissioned roads.

- Ground-based equipment should generally be limited to slopes less than 30.

- Remove as much soil and rock material from tree root systems as possible before trees are removed from the site. Soils in gap opening disturbed through tree removal should be re-contoured as much as possible to resemble pre-activity surface soil conditions. This should include filling of deeper holes and leveling of berms using materials onsite.

- Equipment trails used for activities shall be restored to the pre-activity conditions. Any rutting or berms shall be repaired with deep ripping, and drainage structures installed to control surface runoff as needed.

- Retain as much slash and other coarse woody debris as possible in the gap openings.

Temporary Roads and Access to River:

- Project will utilize existing unclassified and previously-decommissioned roads, and well-established skid trails.

- Install drainage structures on reconstructed unclassified roads where necessary to divert flow before it reaches stream channels.

- Existing roads used for the project shall have minimal grubbing of road surfaces, along with minimal clearing (approximately 12 ft) of existing trees and vegetation. These roads should be restored to the pre-activity conditions. Any rutting or berms shall be repaired with deep ripping and drainage structures installed to control surface runoff as needed.

Rock will be used only when necessary to reduce erosion, puddling, compaction, and applied only where needed (spot rocking) on road surfaces.

- Access road to river (2300-200) is located on a low terrace of the South Fork Skokomish River. This road shall be rehabilitated upon completion of the project. Road will be ripped to a depth of 14 inches, soil, slash and other woody debris will be placed within road prism; road will be seeded/mulched and planted with native trees and other vegetation. Drainage structures and outsloping treatments shall be used to direct water across road prism as close to natural hydrologic flow patterns as possible.

- All reopened roads and major equipment trails accessed from system roads shall have a permanent closure berm placed at road intersection to prevent unauthorized motorized use.

Cultural Resources:

- In the event that archaeological materials are encountered during project implementation work should be halted and the Forest Archaeologist should be contacted in order to assess the discovery and evaluate the significance. In the event that skeletal material or features of burial/interment are encountered, all work must be stopped immediately and contact must be established with local law enforcement, the SHPO and the affected Indian Tribes.

Siliviculture:

- Riparian buffers would be implemented as designated by the fisheries biologist. Areas within riparian buffers would be avoided, and all equipment would be excluded from buffers except for in locations agreed to by the Forest Service.

- Operations would be allowed to proceed during bark slippage period as long as the following standards are met. To prevent scarring to residual trees a standard of at most 5% of stems exceeding 16 square inches of damage and 7% total stems damaged would be in effect during all operations. Damage can be defined as loss of bark, exposing or breaking the cambium layer of the stem or roots. Damaged residual trees would not be removed, but left alive to potentially develop rot columns over time.

- All snags over 12 feet tall would be retained unless they pose a hazard to human safety. Where human safety is jeopardized, however, the snags could be felled, but must be left on-site as coarse woody debris. CWD existing on the site exceeding 6 inches in diameter could be moved for access, but would not be removed from the site, and disturbance would be minimized to conserve CWD in the stands proposed to be used as a wood source. Equipment trails used for access would be blocked after operations to conserve CWD that might otherwise be removed for firewood. Big, old stumps would be kept intact and not uprooted wherever possible.

In-stream Structures:

- All of the logjams will be designed and constructed to remain stable during 100 year flood events. A large portion of each structure will be buried below the streambed.

- All in-stream work would be accomplished during the summer low water period (July 15 – September 15).

Monitoring

- Instream habitat and stream channel changes within the project area will be monitored by establishing a series of photo points and by evaluating plan-form channel changes from periodic aerial photography. Intensive spawning surveys for steelhead and Chinook and occasional red surveys for bull trout within the project area will be used to assess increased fish utilization. The NMFS steelhead supplementation study, the Skokomish Tribe's Chinook reintroduction program, and the ONF bull trout monitoring in the South Fork Skokomish all provide a pre-project baseline for existing fish utilization within the project area.

- Stocking surveys should be performed in gaps in the second or third year following tree removal activity to quantify natural regeneration. Surveys of snags and CWD levels should be undertaken 3-5 years following implementation to ensure that objectives have been met and to assess the need for creation of additional snags or CWD within the proposed areas to be used as a wood source.

- Stand examinations should be performed about 10-15 years following tree removal to determine the necessity for additional treatments that would contribute to the development of the desired late-successional characteristics within these stands. The planted western white pine trees should be assessed for a first pruning treatment to reduce mortality due to white pine blister rust. A second commercial thinning treatment may be warranted to reduce tree density and continue the development of desirable overstory tree characteristics and the vigor of understory trees and vegetation. Additionally, if the understory trees are of sufficient size and density, an understory thinning treatment could promote the development of multiple canopy layers.

- All roads associated with the project will continue to be treated and monitored for invasive plants into the future as necessary.

Comparison of Alternatives

The following table provides information for comparing and summarizing the anticipated environmental effect of the No Action and Proposed Action alternatives analyzed in the final EA.

Table 1. Alternatives and Summary of Effects

Effect	No Action Alternative	Proposed Action Alternative
Fish Habitat	Maintain degraded condition for foreseeable future	Short-term effects due to sedimentation and turbidity. Substantial long-term benefit to stream channel complexity and channel function, temperature, sediment, LW, pool frequency and quality (Pathway Indicator Table 9)
Structure Stability (Potential downstream effects)	LW will continue to enter the river and move through the system, potentially forming jams, aggrading gravels, and causing channel shifts in low gradient areas.	Project will increase the amount of large wood in the river system somewhat. In-stream structures are expected to be stable in high flows. There is a potential for individual logs to mobilize and move below canyon. Losses will likely be offset by structures trapping and accumulating wood from upstream.
Wood Source	No effect on stand development	Enhance horizontal and vertical spatial diversity within stands by creating canopy gaps; and transferring part of the stands' growth potential from the upper canopy to the forest floor within the and around canopy gaps.
Invasive Plants	Noxious weeds exist and may continue to spread due to other disturbances.	Invasive plants will be controlled within the project area. More stable stream channels and floodplains will reduce potential for future infestations.
Recreation	No effect	Structures may increase river obstructions and boating risk to a limited degree.

CHAPTER 3 – ENVIRONMENTAL EFFECTS

Introduction

This chapter provides the basis for comparing the two alternatives, No Action and Proposed Action described in Chapter 2. The chapter is arranged by alternative, with the anticipated effects of each alternative discussed in reference to the major issues listed in Chapter 2.

Description of Existing Environment

Riparian timber harvest and LW removal in preparation of the proposed 1950s dam, exposed streambanks and terraces to erosion, which, in turn, destabilized the vertical and lateral stability of the stream channel and severely impacted fish habitat within the analysis area. In addition to the degradation of aquatic habitat and increased sediment supply created by bank and terrace erosion, subsequent timber harvest, road construction and landslides in the upper watershed also increased the available sediment supply and bedload. This further reduced stability and increased the overall sediment budget of the analysis area, including the South Fork and main stem Skokomish Rivers. Without intervention, these conditions are expected to persist into the foreseeable future. Therefore a restoration effort designed to accelerate the recovery of channel processes, riparian conditions, water quality, and fish habitat is needed.

Direct, Indirect and Cumulative Effects of the Alternatives

ESA Federally Listed Threatened Fish

No Action Alternative
The no action alternative would leave the proposed project area stream channel conditions in their current state. By not improving stream channel conditions the proposed project area continues to maintain degraded channel conditions and degraded river and riparian habitat for fish.

Proposed Action Alternative
Puget Sound Chinook, Puget Sound steelhead, and Hood Canal summer chum have been listed as threatened by the National Marine Fisheries Service (NMFS). Both Puget Sound Chinook and Puget Sound steelhead occur within the planning area. Hood Canal summer chum are considered extirpated from the Skokomish basin (WDFW & PNPTT 2000). Critical habitat for Chinook has been designated by NMFS, which is within the planning area. Coastal Puget Sound bull trout have been listed as threatened by the US Fish and Wildlife Service (USFWS), and occur within the planning area. Currently the USFWS has proposed to designate Critical Habitat for bull trout within the South Fork Skokomish watershed, on National Forest lands, which

would include the planning area. Long term effects of project would benefit Critical Habitat for bull trout.

The preliminary ESA effects determination for the proposed action for Puget Sound Chinook, Puget Sound steelhead, and Coastal Puget Sound bull trout is "Likely to Adversely Affect" due to short-term disturbance, sedimentation, and turbidity related to in-stream activities. Over the the long-term, the project would substantially improve habitat conditions and promote recovery for all three species. The preliminary ESA effects determination for Hood Canal summer chum is "No Effect". Effects determination for Critical Habitat for Puget Sound Chinook is "Not Likely to Adversely Affect", see table 2.

Table 2, Federally Listed Threatened Fish Determinations

Issue	No Action	Proposed Action
Puget Sound Chinook	"No Effect"	"Likely to Adversely Affect"
Hood Canal Summer Chum	"No Effect"	"No Effect"
Puget Sound Steelhead	"No Effect"	"Likely to Adversely Affect"
Coastal Puget Sound bull trout	"No Effect"	"Likely to Adversely Affect"
Critical Habitat for Puget Sound Chinook	"No Effect"	"Not Likely to Adversely Affect"

Essential Fish Habitat
Essential Fish Habitat (EFH) has been designated by NMFS within the South Fork Skokomish watershed under the Magnuson-Stevens Fishery Conservation and Management Act (NMFS 2002). EFH includes all Chinook, coho, and pink salmon habitat. There will be short-term sediment impacts during the construction phase of the project, however the long-term effect on EFH will be beneficial. The project area within the South Fork Skokomish is within Essential Fish Habitat and would be adversely affected.

ESA Federally Listed Marbled Murrelet and Northern Spotted Owl

No Action Alternative
The no action alternative would have no effect on the marbled murrelet or northern spotted owl.

Proposed Action Alternative
The project is located more than 4 miles from the nearest northern spotted owl activity center and less than 3 miles from a historical murrelet site. Surveys were not conducted for either species specific to this project as removal of nesting habitat was not proposed for the proposed action alternative. Using the Biomapper analysis to determine if there is possible owl nesting habitat available within the project area boundaries, no random sites were detected within 5 miles of the project area.

The proposed thinning units are not within nesting habitat for either species, therefore removal of nest trees would not occur. Conservation measures to ensure that potential nest trees would be retained on-site will be implemented. The stands have low levels of downed wood and few, if any large standing live and dead trees. The stands do function as dispersal habitat for the spotted owl and 17 acres of openings within this area would continue to function as dispersal habitat. Overtime it is expected that an understory of deciduous and eventual conifers would initiate

establishment into the created openings and provide near and future habitat to owl prey and eventual nesting habitat to the species.

During helicopter activities where the aircraft would move between the service landing(s), thinning units, and river there would be noise above ambient levels during the early nesting season for both species. The Dennie Ahl Orchard landing and operations around the four units would not incur noise disturbance to the owl and murrelet; not suitable nesting habitat is present within one mile of the units. Approximately 1,700 acres of suitable habitat would be exposed to noise disturbance with use from a large Type I helicopter from the Green Diamond landing. The majority of this harassment is north/northwest of the river where the in-stream structures will be made and have the lower likelihood to not have direct exposure since the helicopter would be shuttling logs between the units and river at the most efficient direction and not beyond the river to the north where the majority of the habitat is located.

The wood source for the project is not within Designated Critial Habitat for either the Northern Spotted Owl or Marbled Murrelet. The in-stream site is within CHU WA-03b for murrelets. Project activities would not remove primary constituent element #1 (nest tree) or primary constituent element #2 (buffering tree to a nest tree).

Table 3. Federally Listed Marbled Murrelet and Northern Spotted Owl Determinations

Issue	No Action	Proposed Action
Northern Spotted Owl and Marbled Murrelet	No Effect	May Affect, Likely to Adversely Affect (Due to Harassment)
Critical Habitat of Northern Spotted Owl and Marbled Murrelet	No Effect	No Effect

Federally Listed Vascular Plants, Bryophytes, Fungi and Lichen Species
There are no Endangered or Federally listed Candidate or Proposed vascular plants, bryophytes, fungi or lichens documented on the Hood Canal Ranger District. There is one Federally listed Endangered vascular plant, *Arenaria paludicola* (marsh sandwort), that is suspected to occur on the Olympic National Forest (USDA Forest Service, Pacific Northwest Region, Federally Listed, Proposed and Candidate Species, and Proposed or Designated Critical Habitat, April 2004). It grows mainly in wetlands and freshwater marshes, from sea level to 1476 feet in elevation, and can grow in saturated acidic bog soils and sandy substrates with high organic content. Eight of the nine California occurrences are considered extinct (Washington State Natural Heritage program, 2005). It is considered extirpated from the state of Washington.
There are no known current or historical sites of this species within the proposed project area and due to lack of suitable habitat it is not likely to occur.
There would be no direct, indirect or cumulative effects of this Federally Endangered plant. Therefore, the implementation of this project would not affect the viability of this species.

US Forest Service Regional Forester's, Region 6 Sensitive Species

Sensitive Fish Species
Fish species on the Forest Service Region 6 Sensitive Species List that occur within the planning area and may be potentially affect by the project are: Puget Sound/Strait of Georgia Coho

Salmon, Puget Sound Coastal Cutthroat Trout. Effects determination for these two sensitive fish species is "*May Impact* Individuals Or Habitat, But Will Not Likely Contribute To *A* Trend *Towards Federal Listinq Or Cause A* Loss Of *Viability To the Population or Species,"* infact the proposed project will have a beneficial long-term effect on the habitat of these two sensitive fish species. The project would have "no effect" on River lamprey, which potentially may occur in the lower watershed.

Table 4. Region 6 Sensitive Fish Species

Fish Species	Proposed Action			
	No Effect	May Impact Individuals Or Habitat, But Will Not Likely Contribute To A Trend Towards Federal Listinq Or Cause A Loss Of Viability To the Population or Species	Will Impact Individuals Or Habitat With A Consequence That The Action Will Contribute To A Trend Towards Federal Listinq or Cause A Loss Of Viability To The Population Or Species	Beneficial Impact
Olympic Mudminnow	X			
River Lamprey	X			
Puget Sound/ St Georgia Coho Salmon		X		X
Lake Pleasant Sockeye Salmon	X			
Puget Sound Coastal Cutthroat Trout		X		X
Olympic Peninsula Coastal Cutthroat Trout	X			

Table 5. Region 6 Sensitive Species

Issue	No Action	Proposed Action	
	No Effect	No Effect	May Impact Individuals Or Habitat, But Will Not Likely Contribute To A Trend Towards Federal Listing Or Cause A Loss Of Viability To the Population or Species
Puget Oregonian (snail)	X		X
Burrington's (Keeled) Jumping Slug	X		X
Warty Jumping Slug	X		X
Malone's Jumping Slug	X	X	
Evening Fieldslug	X	X	
Oregon Megomphix (snail)	X		X

Blue-gray Taildropper Slug	X		X
Hoko Vertigo	X	X	
Van Dyke's Salamander	X		X
Cope's Giant Salamander	X		X
Olympic Torrent Salamander	X		X
Common Loon	X	X	
American Peregrine Falcon	X	X	
Bald Eagle	X		X
Harlequin Duck	X		X
Townsend's Big-Eared Bat	X	X	
Keen's Myotis	X		X
Pacific Fisher	X		X
Olympic (Western) Pocket Gopher	X	X	
Olympic Marmot	X	X	
Johnson's Hairstreak	X		X
Taylor's Checkerspot	X	X	
Olympic Arctic	X	X	
Dog Star Skipper	X		X

Vascular Plants
As no sensitive vascular plant species were found in the project area, there would be no direct, indirect or cumulative effects to these species. Implementation of either alternative would have no risk to species viability or a trend toward listing.

Bryophytes
As no sensitive bryophyte species were found in the project area, there would be no direct, indirect or cumulative effects to these species. Implementation of either alternative would have no risk to species viability or a trend toward listing.

Fungi
As no occurrences of Bridgeoporus nobilissimus were found in the project area, and no other sensitive species of fungi are documented to occur in the project area, there would be no direct, indirect or cumulative effects to these species. Implementation of either alternative would have no risk to species viability or a trend toward listing.

Lichens
Sensitive lichen species were assessed for the South Fork Skokomish Large Wood Enhancement Project planning area in November, 2008. Four sensitive lichen species documented to occur on the Olympic National Forest were identified as having potential habitat within the proposed

project area. Two of these species, Platismatia lacunosa and Usnea longissima, are known to occur in the South Fork Skokomish watershed.

No Action Alternative
Under the No Action Alternative no active management activities would occur that might damage the structural integrity of the substrates being occupied by the single occurrence of the sensitive lichen species Usnea longissima documented within the project area. Natural processes would continue to dominate, canopy cover would remain high and the microclimate would remain essentially the same. There would be no effects to this sensitive lichen under the No Action Alternative, and there would be no risk to species viability or a trend toward listing.

Proposed Action Alternative
Under the Proposed Action Alternative the potential exists for the small population of Usnea longissima to be damaged or obliterated during the felling or removal process. Removal of canopy adjacent to the occupied site might also result in changes in microclimate and loss of dispersal habitat. These effects will be eliminated by maintaining a 150 foot radius no-removal buffer around the occurrence of this sensitive lichen. However, since the old road that will be used to access the unit intersects with this buffer, a limited number of trees may be felled or removed from within this buffer inside the road prism only if this is necessary to allow access for equipment. Damage or removal of red alder or big leaf maple 12" DBH or greater should also be minimized as much as possible in all tree removal units to diminish the loss of this type of habitat. With implementation of these mitigation measures, there would be no risk to species viability or a trend toward listing for sensitive lichens as a result of this project.

Cumulative Effects
In the past 80 years, the units proposed for tree removal have been clearcut and replanted. It is reasonable to assume that lichen species richness, in general, declined in these areas as a result of this habitat loss and fragmentation. Further detrimental effects on sensitive lichens that could result from current proposed project will be reduced or eliminated by incorporating the mitigation measures described in this document. Therefore, cumulative effects would be negligible.

Wildlife

Table 6. Olympic National Forest Management Indicator Species Determinations

Issue	No Action	Proposed Action
American Marten	No Effect	No Impact
Pileated woodpecker, primary cavity excavators	No Effect	Minor impacts to individuals are possible (if individual roost trees are removed for hazards). Standing dead not removed unless determined hazard.
Roosevelt elk and Columbia black-tailed deer	No Effect	Short term negative impacts to individuals from disturbance but positive impacts from created openings and subsequent plantings.

Neotropical Migratory Birds

Table 7. Neotropical Migratory Bird Determination

Issue	No Action	Proposed Action
Neotropical Migratory Birds	No Effect	Short term minor impacts possible to individuals of some species. Longer impacts will be positive for early seral species. Hardwoods would be retained.

U.S. Fish & Wildlife Service Species of Concern

Table 8. Species of Concern Determinations

Issue	No Action	Proposed Action
Makah Copper Butterfly	No Effect	No Effect
Long-legged Myotis and Long-eared Myotis	No Effect	May Effect individuals (if individual roost trees are removed for hazards) but implementing this alternative would not contribute toward a need for conservation action for the long-legged Myotis and long-eared Myotis. Longer term impacts expected to be positive.
Northern Goshawk, Olive-sided Flycatcher	No Effect	May Effect, but with implementation of this alternative. Created openings will provide habitat for prey species for both birds.
Cascades frog, tailed frog, western toad	No Effect	May Effect individuals in short term but implementing this alternative would not contribute toward a need for conservation action for the Cascades frog, tailed frog, and Western toad. Longer term impacts would be expected to be positive (water quality, connectivity)

Other Issues

Fish Habitat

Selected indicators from the "Matrix of Pathway and Indicators" taken from the 1996 NMFS document, "Making Endangered Species Act Determinations of Effects for Individual or Grouped Actions at the Watershed Scale" were used to analyze the different alternatives. Indicators selected from the matrix are representative of habitat features that can be affected by large woody debris project. Indicators selected from the matrix are: temperature, sediment, substrate embeddedness, large woody debris, pool frequency and quality, large pools, width/depth ratio, streambank condition, and function of riparian reserve (Table 9). The proposed alternatives were analyzed from these selected indicators to assess potential

environmental effects based on existing conditions at the project and watershed scale. The ratings of these indicators show relative change to the baseline, and display if the action would have a beneficial, neutral or negative impact on the habitat indicator.

Table 9. Selected Indicators Taken from the Matrix of Pathway and Indicators (NMFS)

	Baseline (Watershed Scale - 5HUC)			Effects of Proposed Alternatives (Project Scale)		Effects of Proposed Alternatives (Watershed Scale)	
Indicator	Properly Functioning	At Risk	Not Properly Functioning	No Action	Proposed Action	No Action	Proposed Action
Temperature		SF, NF		M	R	M	M
Sediment		SF, NF		M	R/d	M	M
Substrate Embeddedness		SF, NF		M	R/d	M	M
Large Woody Debris		NF	SF	M	R	M	M
Pool Frequency and Quality		SF, NF		M	R	M	M
Large Pools		SF, NF		M	R	M	M
Width/ Depth Ratio		SF, NF		M	R	M	M
Streambank Condition		SF, NF		M	R/d	M	M
Riparian Reserve		NF	SF	M	R/d	M	M

(R)estore = project is likely to have a beneficial impact on habitat indicator
(M)aintain = project may affect indicator, but impact in neutral
(D)egrade = project is likely to have a negative impact on the habitat indicator.
d = Short-term negative impact, associated with project implementation phase.
SF = South Fork Skokomish River
NF = North Fork Skokomish River

Direct and Indirect Effects

Temperature

No Action Alternative
Under the no action alternative maximum water temperatures would continue to be negatively affected by poor channel stability, stream width to depth ratios, and riparian conditions. Current degraded condition would be "maintained." Stream temperatures would be expected to improve at a rate consistent with current trends. If the riparian canopy cover continued to increase (which it may not because vegetation in the active floodplain gets reset every 5-15 years), and width to depth ratios slowly improved, stream temperatures would decrease to more optimal levels for fish over 50 years or more.

Proposed Action Alternative
Under the action alternative maximum water temperatures would incrementally decrease as a result of stabilizing streambanks, reducing width-to-depth ratios, protecting riparian vegetation and increasing stream shade in the long term. McHenry et al. 2007 have observed that

engineered log jams can create cooler temperature microclimates by the scour pools which have been created by the install log complexes. Water temperature decreases would reduce to salmonid stress in the summer months and improve habitat conditions for fish. The combined effects of the project actions on temperature are classified as "restore."

Sediment and Substrate Embeddedness

No Action Alternative

The no action alternative would have no impact on sediment input and substrate embeddedness, current conditions would be "maintained." Lateral stream migration and accelerated bank erosion would continue to contribute to the sediment load of the South Fork Skokomish watershed. However, over 50-100 years or more, as riparian forests recovered, and the volume of in-stream large woody debris increased, bank stability and sediment input would slowly begin to improve.

Proposed Action Alternative

Project construction would cause some short term increases in sedimentation and turbidity to the South Fork Skokomish River, exceeding Washington State turbidity standards. Heavy equipment crossing the river and operating on the banks during structure excavation and placement will generate turbidity pulses in the immediate vicinity of the disturbance. Monitoring of the 1997 Hatchery Reach Restoration project on the Wind River, southwest WA (a project similar to the South Fork Skokomish Large Wood Enhancement Project), showed that turbidity levels in the direct vicinity of heavy equipment may exceed 200 times the upstream turbidity levels. This elevated turbidity dissipates rapidly as the suspended sediment settles out of the water column downstream. Monitoring data also indicates that turbidity pulses typically subsided less than one hour and typically were not detectable one mile downstream (Hatchery Reach Water Quality Monitoring, 1997).

The negative short term effects to fish and their habitats would result from the short term increase in turbidity and sedimentation during the construction phase. As previously discussed, the levels of fine sediment and turbidity increases within the project area are expected to be short in duration and below lethal levels. The increases in suspended sediments anywhere in the project or action area are expected to be below levels that are documented to have a negative effect on salmonid rearing habitat (Newcombe and Jensen 1996). Adverse effects to fish would be short term and would occur during construction. The impact to the overall populations is expected to be very small and limited to fish within and potentially one mile downstream of the project reach. The in-stream implementation phase of this project would occur post fry and smolt emigration.

LW structures installed into the banks are expected to dramatically increase bank stability and reduce sediment inputs after installation. Monitoring of 1996 restoration efforts in Layout Creek, on the Gifford Pinchot National Forest demonstrated that in-stream log structures increased bank stability from 60% stable to 80% stable and reduced the annual sediment load in treated areas from 330 cubic yards to less than 30 within four years (USDA 2000).

Direct mortality of aquatic macro invertebrates within the project area is expected. This impact would be brief (12 hours) after disturbance and will be limited to the treatment reach and approximately 1 mile downstream. Based on research by Novotny and Faler (1982), re-colonization of aquatic invertebrates from upriver reaches could occur rapidly due to species

dispersal from in river drift. Gersich and Brusven (1981) estimated that full aquatic insect colonization of rock substrates within disturbed areas would take 47 days.
Short term turbidity and sediment in spawning gravels are expected to increase within the immediate project area – no more than one mile downstream of project area. Therefore, the short term direct and indirect effects of the project actions on sediment and turbidity and substrate embeddedness are expected to move the baseline condition toward a "degrade" rating for the short term (approximately two to three months during construction).
Log complexes are expected to retain some amount sediment within the project reach, however effects of sediment retention would likely not be observable in lower Skokomish River. Studies have shown that large wood complexes not only catch sediment but the size of sediment that is retained increases spawning habitat for salmonids(McHenry et al. 2007).
However, rehabilitation of the eroding banks will provide long term benefits to fish and the aquatic environment by reducing fine sediment inputs for the long term. Therefore, the long term direct and indirect effects of the project on these indicators are considered "restore."

Large Wood

No Action Alternative
The no action alternative would have no impact on the volume of in-stream large wood, current degraded conditions would be "maintained." Although currently there are limited sources of large wood recruitment, as competition for resources and other density dependent factors encouraged self-thinning in the overstocked riparian forests, new sources would develop and volumes of in-stream woody debris would slowly recover in the long term (50-100+ years). The lack of LW (large wood) within the project area will continue to inhibit juvenile salmonid rearing habitat, suitable spawning sites, and habitat diversity.

Proposed Action Alternative
The placement of LW complexes used to stabilize streambanks, or placed on floodplains will in the short term directly increase the amount of wood within the project area to the range of natural variability which will in turn increase hiding cover, reduce width to depth ratios, increase pool quality and quantity and retain nutrients. Therefore, the effect of this alternative on this indicator is classified as "restore."
The addition of LW would dramatically increase channel complexity and protect riparian vegetation. Benefits to adult and juvenile salmonids from the additions of LW include the addition of cover, increase pool depths and retention of carcasses and other organics. The marine-derived nutrients associated with salmon carcass decomposition are now known to play a major role in the productivity of aquatic and riparian systems, within watersheds with anadromous fish in the Pacific Northwest (Cederholm 2000). The addition of LW and the increased retention of these nutrients would indirectly affect all ecosystem aspects, ranging from stream micro-organisms and benthic macroinvertebrates, to top level predators such as eagles and bears.
Implementation of this alternative would in the short and long term indirectly benefit both juvenile and adult salmonids by creating large lateral pools for rearing and resting during migrations and over-wintering. Monitoring in the "Mining Reach" of the Wind River, on the Gifford Pinchot National Forest documented increase in bank full pool volume within a half mile reach by up to 520% (USDA 2000).

In the long term, salmonids would also benefit from restored and self-maintained levels of channel complexity. LW would also provide roughness elements that would help regulate bed load movement of the river channel and fine sediment deposition on the flooplain through time.

Pool Frequency, Quality, and Large Pools

No Action Alternative
The no action alternative would have no impact on pool frequency, quality, and large pools, current degraded conditions would be "maintained". Pool frequency, quality, and large pools would be expected to slowly improve in the long term more than 50 years, as other stream attributes recover.

Proposed Action Alternative
The LW structures are designed to scour pools and decrease width-to-depth ratios. Additional pools will be created by these structures and existing pools will be enhanced. Therefore, the direct and indirect effects of the proposed action on these indicators are classified as "restore."

The increase in large pools will directly and indirectly benefit all species and life stages of fish by providing low water velocity resting habitat and bubble curtains and depth that provide hiding cover from predators. In addition, the increase in large pool habitat will indirectly increase foraging efficiency for juvenile and resident life stages of fish.

Streambank Condition

No Action Alternative
The no action alternative would have no impact on this indicator, currently conditions would be "maintained." Under the no action alternative lateral stream migration and accelerated bank erosion would continue to contribute to the sediment load of the South Fork Skokomish watershed within 10 years. Over the long term (50-200+ years), as riparian forests begin to recover, and the volume of in-stream large wood debris increases, streambank conditions and sediment inputs are expected to slowly improve.

Proposed Action Alternative
As previously discussed in the Sediment, Turbidity, and Substrate Embeddedness section of this assessment, bank stability is expected to be dramatically increased and, thus the short term direct effects of the proposed action on this indicator are classified as "restore." Benefits to fish are described in the Large Woody Debris, Sediment, Turbidity, and Substrate Embeddedness sections of this assessment.

Width/Depth Ratios

No Action Alternative
The proposed treatment reach of the South Fork Skokomish River tends to be relatively wide and shallow. In the summer of 2007 width-to-depth ratios were measured, in areas without significant LW, resistant bank material, and adequate riparian vegetation width-to-depth ratios

averaged 96:1 (USDA TEAMS Enterprise 2007). This indicates an extremely wide and shallow stream. Low flow and bankfull width to depth ratios within the project area will continue to be indirectly negatively affected by poor channel stability for the long term. Therefore the no action alternative would "maintain" a degraded condition for this indicator.

Proposed Action Alternative
Large wood structures and increased bank stability would provide a more defined river channel with greater lateral resistance, which will indirectly decrease width-to-depth ratios in the short term. Analysis of previous restoration efforts suggests that width-to-depth ratios may be reduced by one-third or more in the year following structure installation (USDA 2000). This immediate enhancement of channel morphology would foster recovery of riparian vegetation and improvement of stable riffle and pool development. Reduction of width-to-depth ratios and increased stream shade in the long term will also incrementally decrease water temperatures. Consequently, the indirect effects of the action alternative on this indicator are classified as "restore."

Riparian Reserves

No Action Alternative
The no action alternative would have no impact on riparian forests over the short-term (0-10 years), current conditions would be "maintained." The overstocked riparian forests would likely grow at current rates, with steady improvement in forest structure and diversity as trees became more mature and increased self-thinning occurred. As hydrologic function improves in the South Fork Skokomish, site-specific characteristics, such as soil moisture and chemistry, and the availability of sunlight and nutrients, will effectively determine what tree species are best suited for any given site. Douglas fir can be expected to remain the dominant species on drier sites, however should the water table rise and soil moisture increase substantially, greater abundance of Western red cedar would be expected. Over the long-term (50-100+ years), root networks would help stabilize soils, canopy cover would more sufficiently shade streams, and sources of large wood recruitment would begin to be re-established.

Proposed Action Alternative
During the construction phase along the riverbank some trees may be taken down as excavators dig the log structures into the bank. These trees will be incorporated into the constructed log complexes. There will be one temporary road (approximately 0.5 mile) rebuilt on an old road grade to access the South Fork Skokomish River. No large trees will be cut and only small hardwoods and shrubs will be removed to provide access. These disturbances will be minor and short term, and are expected to revegetate in one year. The following spring after the construction phase, the decommissioned roadbed will be planted with native vegetation and trees. Planting may be postponed a year or two pending the need for use of the access road for Phase II of the project. Consequently, there will be a short term "degrade" to this indicator during the construction phase, but the project effects will have a long term "restore" to the Riparian Reserve.

Short term indirect effects to salmonids would occur from ground disturbance resulting in increased turbidity during excavation within the channel as discussed in the sediment and turbidity section of this report. In the long term (30+ years), stabilization of the floodplain and

accelerated recovery of riparian areas would indirectly benefit salmonids by providing stream shade, bank stability and future recruitment potential for LW.

Fish Habitat No Action Cumulative Effects

The detrimental effects from no action would be more correctly termed as indirect effects of the lack of recovery from past degrading actions rather than cumulative effects from no action. The proposed project area is a portion of approximately 4 miles of the South Fork Skokomish River channel which has been highly disturbed by the historic logging and road building activities, related to preparation of a proposed dam in the 1950's. By not improving channel conditions with this alternative, the proposed project area continues to maintain degraded channel conditions and degraded river and riparian habitat for fish. These disturbed channel segments are in the Lower South Fork Skokomish subwatershed and has the potential to provide high quality of fisheries and riparian habitat.

Past timber harvest and associated road building represent the primary management activities that contribute to cumulative effects and degradation of aquatic habitat and the fishery resource in the South Fork Skokomish River. Subsequent flooding has also compounded the negative effects and have slowed the rate of recovery of the watershed, stream network, aquatic habitat and fisheries. Restoration efforts in the upper watershed have primarily been road decommissioning to prevent road related mass wasting and sediment delivery from to streams.

Future timber harvest, road construction and maintenance within the watershed will result in incremental increases in fine sediment which could be delivered to fish bearing streams through the road ditch network. However, sediment produced form timber harvest are not expected to accumulate to measurable levels, above background, because of riparian protection measures incorporated into all harvest unit designs on public land. Sediment introduced into the system during road construction activities would incrementally affect width-to-depth ratios, pool depth and spawning gravel.

Fish Habitat Proposed Action Cumulative Effects

Fine sediment would be introduced into the South Fork Skokomish River during construction phase of this alternative. This added sediment pulse would be indistinguishable when seasonal high flows occur in the fall, following project implementation. There would be no measurable effect downstream habitat attributes approximately 1 mile below the project reach or forest boundary. The completion of the future timber harvest activities, road decommissioning, and culvert replacements would cause short term flushes of sediment during the first high flow event however sediment produced from the proposed action would not cumulate to measurable levels, above background, because of riparian protection measures and project design criteria incorporated in all projects. Increased turbidity generated during construction activities could displace fish temporarily. Fine sediment deposited within the project area associated with implementation phase is expected to be undetectable within spawning areas the following spring. Currently fall spawning fish – bull trout, Chinook salmon, and coho salmon – spawn above the project reach. The proposed action combined with other restoration activities, primarily road decommissioning within the South Fork Skokomish watershed, over time will cumulatively improve fish habitat conditions.

Structure Stability

Log structure stability and durability calculations were based on 100 year flood event. HEC-RAS modeling was used to evaluate the flow regime and determine the channel behavior during different flooding scenarios. The results provided graphical and numerical information necessary for the appropriate allocation, design, and placement of LW structures along the reach. Standard hydraulic calculations were used in the stability analysis which incorporated critical velocities that predict the sheer stress acting on the banks and streambed. A number of other factors were used in the stability analysis, such as scour depth, buoyancy force, and impact force from other debris to name a few. Considering the potential for increased flows due to climate change, the design team overdesigned the structures by using a design factor of safety of 2. This resulted in structures being buried deeper and the use of longer key pieces within the structure.

If the structures experience greater than Q100 flows, they would still be expected to remain stable. Higher flows would actually decrease the stress on the structures because more of the structure would be inundated and there would be less torque. Buoyant forces would of increase and some of the smaller log pieces would likely float off, but this would not result in a critical failure. A more likely scenario than structure failure would be that the bedload movement would increase with higher flows and some of the structures may be buried temporarily by streambed deposits and aggradation. This would be considered part of the natural fluvial processes.

The LW structures are expected to be dynamic and function similar to natural wood accumulations. Occasional losses of individual wood pieces from the structures are anticipated. However, the anticipated wood losses would be offset by the tendency of the structures to accumulate additional wood by trapping pieces floating down from upstream. Given the amount of large wood that is currently in the South Fork Skokomish River channel upstream of the project area, the tendency for the structures to trap and accumulate additional wood, the constriction the gorge poses to wood movement, and distance the wood would have to travel from the project area to the lower Skokomish valley, it would be highly unlikely for wood pieces placed as part of this project to create substantial adverse impacts on flooding in the lower valley.

To meet the goal of accelerating the recovery of stream channel stability and rehabilitation of aquatic habitat, restoration of LW levels is essential. In order to achieve the greatest cost to benefit ratio, large wood structures will be strategically placed relative to the natural hydraulic frequencies and scour and deposition intervals. Each structure has a specific set of objectives and varies in function and form. The following presents the various structures that will be constructed for this project. (USDA 2009)

Three structure types that emulate stable natural LW accumulations will be employed for this project; formidable multi-faceted (FMF) structures, gravel bar structures and ribs. Over the past 15 years, these structures have been successfully constructed in a variety of fluvial systems and have endured a wide range of discharges and sediment regimes in Alaska, Washington, and Oregon. Structure designs are based on basic engineering principals and hydraulic constraints. In general, the structures are composed of whole trees and full-length logs with key pieces keyed or buried into stream banks, gravel bars, and floodplains for stability. Plan view placement of the

structures relative to natural hydraulic frequencies (meander frequency, belt width, pool spacing, and radius of curvature), and construction elevations of the structures associated with maximum scour depths and flood-prone elevations are paramount to long-term stability of the structures and overall achievement of objectives.

The risks of failure, the failure mode, and potential consequences and effects to the system and lives and property associated with each component of the design are considered in Table 10, adapted from Niezgoda and Johnson, 2007.

Table 10. Restoration design components and potential risks, causes and effects of failure.

Treatment	**Potential Failure Mode**	**Potential Effects of Failure**	**Potential Causes or Mechanisms**	***Risk Priority #, (1-10, 1-low, 10-high))**	**Design Checks**
FMF Structures (Barbs and Complexes)	Burial by Incoming Sediment	Project Not Effective	Insufficient Design Considerations or Catostrophic Event	3	Allowable Shear Stress Check
	Rapid Lateral Migration	Property or Infrastructure Damage	Improper Design, Structure Placement & Specifications	3	Design Layout, Peer Project Reivew & Design Experience
	Erosion of opposite Bank	Minimal, some sediment input	Improper Design, Placement or Alignment	2	Design Layout, Peer Project Reivew & Design Experience
	Structure Displacement	Minimal, reduce design effectiveness	Improper Material Sizing, Poor Construction Oversight or Design	3	Use Largest Cost Effective Materials – Provide Continuous Construction Oversight
	Excessive Scouring of Bed- BF Channel shear 1.71 lb/sq ft	Potential to cause structure failure	Improper Design	7	Follow Design Guidelines for Structures, scour/ shear stress check
Bar Buddies, Bar Ribs and Riparian Ribs	Burial by Incoming Sediment	Minimal	Insufficient Design Capacity	3	Allowable Shear Stress Check
	Rapid Lateral Migration	Property or Infrastructure Damage	Improper Design, Placement or Alignment	5	Design Layout, Peer Project Reivew & Design Experience

	Erosion of opposite Bank	Minimal, some sediment input	Improper Design, Placement or Alignment	2	Design Layout, Peer Project Review & Design Experience
	Structure Displacement	Potential to cause structure failure	Improper Material Sizing, Poor Construction Oversight or Design	3	Follow Design Guidelines for Structures. Use Largest Cost Effective Materials – Provide Continuous Construction Oversight

Restoration failure mechanisms are evaluated for relative risk of occurrence. Higher numbers indicate higher risk of occurrence with the present design. For higher risk priority numbers, recommended actions will be identified to address potential failure modes and remedies. Recommended actions may include new design elements, inspections, monitoring procedures, and design modifications.

Several treatments will take place as part of this project. For each treatment, there is a potential for failure, and a range of effects that may occur as a result of the failure. Treatment failures for this project are not expected to result in risks to lives or property, and anticipated effects are quantified in Table 10. For each structure, potential failure modes, the effects of failure, potential causes or mechanisms, and design checks are discussed.

Risk priority numbers have been provided in Table 10. They show the design features that will be used for the project and provide a 1-10 ranking of potential failure modes of each design component. The failure modes that have the highest risk of occurring require a hard look at design components to insure that there has been consideration of the potential failure mechanisms and adequate design features employed. Also, once the project is implemented, additional monitoring should take place of features with higher risk priorities.

Formidable Multi-Faceted (FMF) Log Complexes and Terrace Barbs

FMF structures will be built as a complex to help stabilize areas of unstable banks and eroding terraces. There is a low risk to lives and property from FMF structures. The construction elements of these structures are designed to minimize risk of failure yet provide maximum effectiveness of providing bank/terrace protection and enhancement of fish habitat. They are based on multiple years of on the ground experience in a wide range of stream systems in the Pacific Northwest and Alaska. Experience has shown the design for the FMF structures will be adequate to insure the stability of the treated banks. These types of structures have been placed on the White River in Washington State and have experienced streamflows of over 8,000 cfs, and placed on several smaller river systems where they have been effective at stabilizing banks for over 100-year flood events. In the unlikely event that these structures fail, it is likely that large woody debris used for the structures will be transported downstream and either re-deposited elsewhere or transported by the river to the Skokomish River downstream and

ultimately to the Ocean. There is a relatively low risk that this material will cause a risk to areas downstream, especially at bridges or culverts. Downstream bridges have design flow capacities that currently accommodate large wood transported by the stream. Large wood is a natural component of flood debris in rivers, and the amount that could be generated from these structures will not exceed what is normally observed in rivers at flood stage. Highway 106 and 101 bridges are located at river mile 2.2 and 5.3 on the main stem Skokomish River respectively. Both bridges have active spans that can accommodate passage of flood debris. The longest and largest trees proposed to be used for the project would be approximately 80 feet in length. These pieces would be used as key pieces or torsion logs for the structures, as described in the design drawings, and would be buried to greater than 70% of their length into the banks and or stream bed. There are no culverts downstream of the project site.

The South Fork Skokomish River in the project reach is moderate in terms of energy with ample opportunity to dissipate energy and the likelihood of failure from shearing of structure or torsion logs is low. The reach where these structures are proposed have stream slopes less than 1%. Stream slope is a direct measure of energy where streams that are considered high energy have slopes greater than 2% (Castro 2009).

Failure of these structures is defined as the point at which the structure is degraded or eroded or abandoned to the point of being ineffective. In the event of structure failure, wood would be lost downstream, while other pieces would be altered from their original placement or remain in place. Since there is a considerable amount of material in these structures, partial loss of wood may occur and not affect the structures ability to stabilize the bank/terrace. If the stream avulsed and formed a new channel, structure failure would result since the structure would potentially be left "high and dry" and no longer be effective and in the active channel. Failure of FMF structures might occur by burial of the structures by incoming sediment coming from upstream sources. The South Fork Skokomish Project area is a response reach of the river, and is an area where sediment and LW tends to accumulate over time, until it is transported downstream by larger floods. The potential for enough sediment to accumulate to cause FMF structure burial is very low.

The structures are constructed with decreasing cross-sectional area in the streamside direction as much as possible to still perform the desired effect. By the same token the buried portions of the structures will be as large of a cross-section as possible. The sheer bulk of the structure may not be as important as cross-sectional area perpendicular to direction of force (current) applied. Therefore FMF structures are angled up-stream at 30 degrees or less from the bank. The angle of the structure reduces both the cross-sectional area perpendicular to flow and the torsion force exerted on the structure.

All structures are also strategically placed along historic and predicted channel migration patterns in close association with modeled high shear/scour and deposition areas. In addition and perhaps most importantly, cross-sectional area is closely scrutinized and incorporated into the construction of all structures.

Each of these structures is given a high degree of construction oversight; each key piece is individually placed at specific angles with subsequent pieces placed to interlock or secure the

preceding piece. To the greatest extent possible, trees are woven and interlocked to form a cohesive whole structure, as opposed to a scattered pile of loose logs acting semi-independently.

The mechanism with the highest risk priority number for possible structure failure is bed scour adjacent to the structure. FMF structures are designed to initiate and or increase scour along the bed along the base of the structure therefore the potential for undermining the structure exist. The design considers this risk, and mitigates the potential by constructing the structure deep enough into the bed so that the risk of failure from scour is significantly reduced. Bankfull channel shear forces have been calculated to be 1.71 lb/sq ft, enough to mobilize the bed material. Structure depth will exceed the depth of the deepest pool at the study site by at least a 25 % factor of safety, and possibly deeper, depending on site conditions. Maximum scour was estimated based on empirical measurements taken in 2008 for a surveyed reach extending over several miles. Maximum residual pool depths were measured for over five of the deepest pools observed which ranged in the types of scour (bend scour, local, constriction, drop or jet scour) and would also account for the cumulative effects of each type of scour if encountered at a pool or scour zone.

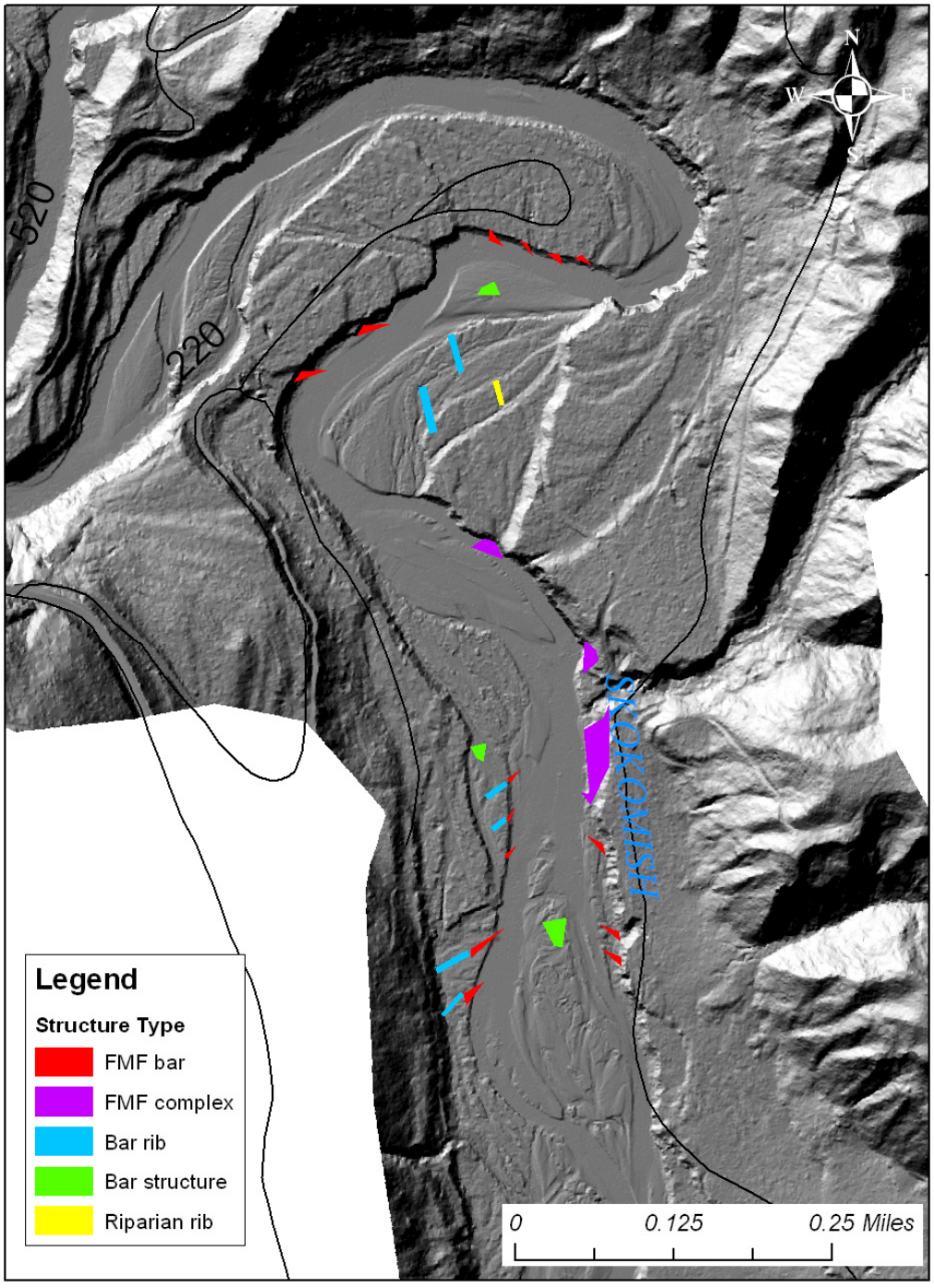
Bar Buddies, Bar Ribs and Riparian Ribs

These treatments will be used to create or enhance islands, point bars and flood plains and to reestablish or protect riparian vegetation. There is a low risk to lives and property from failure of these structures. These structures are placed in depositional areas where stream bed shear stress is low. In the unlikely event that these structures fail, large woody debris may be transported downstream. There is a very low likelihood of these structures causing other adverse effects.

Because Bar Buddy and Rib structures are placed in depositional areas and designed to accumulate and meter sediment, failure of these structures could occur from burial by incoming excessive sediment. This reach is a response reach, where sediment accumulates between larger flood events, so sediment accumulation has occurred in the past. The structures are constructed on flood plains, islands and point bars, which are all typically depositional areas, and deposition is expected. However large scale landslide events, mass wasting upstream of the project area or catastrophic flood events could deliver enough sediment to overwhelm the structure design capacity which would result in burial of the structure. If structures do become totally buried, they would likely still meet their primary intended objective of reducing width to depth ratios.

However if the sediment accumulation intrudes into the cross-sectional area, shear stress would increase on the outside of the meander belt near locations where FMF structures are constructed resulting in excessive scour and potential loss of those structures. However there is a low risk of Bar Buddy or Rib structures causing rapid channel lateral migration, erosion of the opposite banks, or actual structural displacement. Rapid lateral migration would be held in check by the FMF structure due to the additional safety factor precautions previously discussed. Therefore bank erosion or loss of FMF structures would be limited or non-existent due to structural improvements on the opposite bank (USDA 2009).

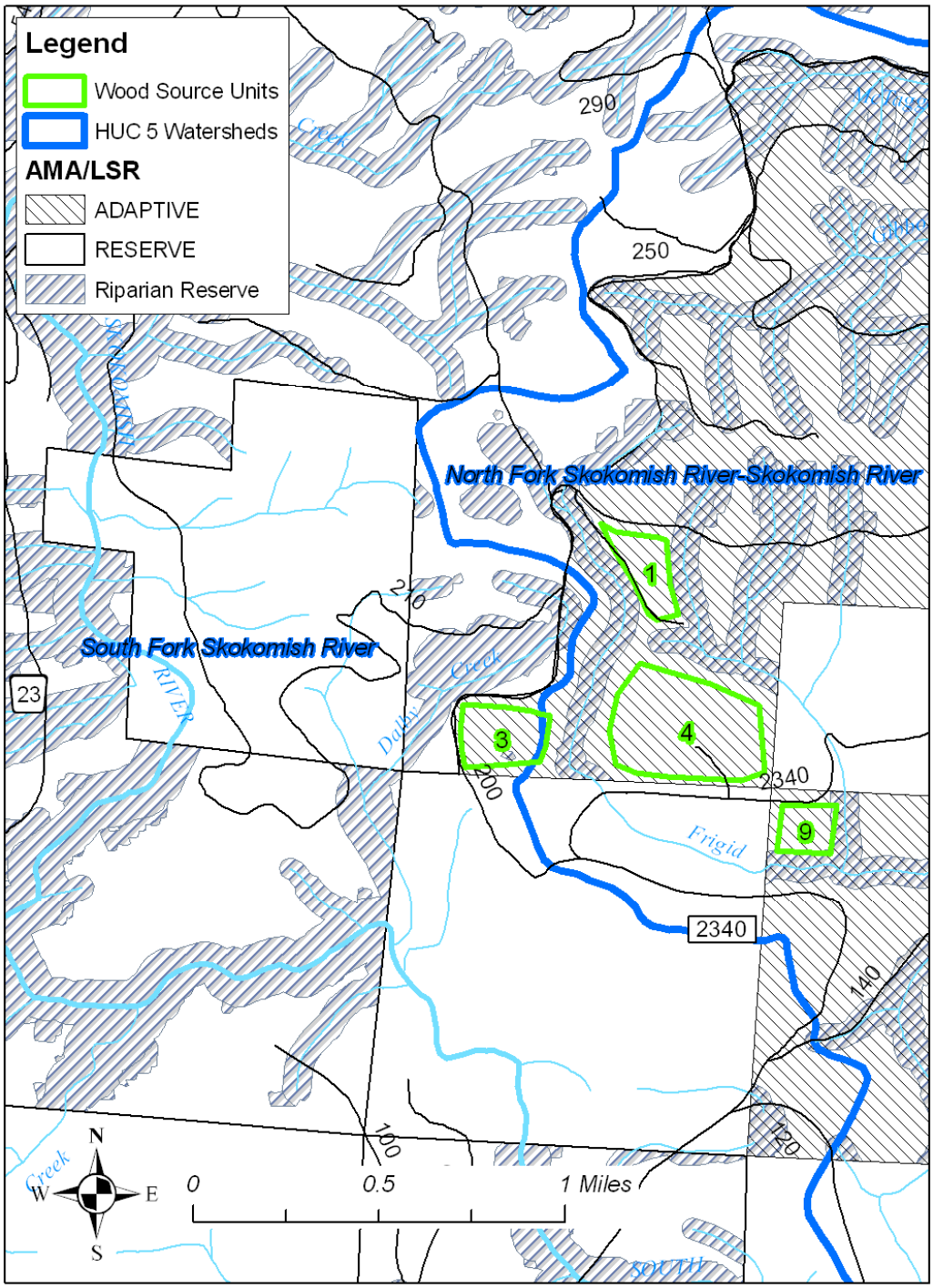
Map 2. Structures



Wood Source

Approximately 2,700 whole trees would be needed to provide the necessary large woody material for the project. Trees ranging from 6 to 30 inches in diameter would be removed from about 17 acres in gap openings within 115 acres of second-growth forest stands in the North Fork and South Fork Skokomish subwatersheds. Most of the trees would be knocked down with an excavator and removed with their roots attached. Some of the trees would be felled by chainsaw. Tree removals would create a variety of small (1-1.5 acres) openings. In some cases, individual trees would be selectively removed to minimize changes in the stand canopy. All tree removals would be coordinated with widlife and silviculture specialists to accomplish multiple objectives. Knocking over of trees would begin in early June and continue until early July.
All stands are within the AMA.
Map 3 and table 11 summarize the proposed tree removal and access requirements by stand unit. The units proposed include approximately 115 acres of AMA lands.
AMA Stands – Units 1, 3, 4, and 9:
One to one and half acre openings would be distributed along old road grades within units. Openings would be approximately 100 feet from system roads, and would be approximately 200 feet from one another. The openings or gaps would be about 15% of the unit area.
Use of helicopter would be used to transport trees from units to the river. Helicopter operations would occur in early to mid July. Potential helicopter service landing will be on Green Diamond Timber Company lands. During helicopter operation the follow Forest Service roads would potentially be closed: 2340 from MP 4.4 to 5.5, 2340-200 MP 0 to 2.0, 2340-210, 2340-230 at MP 0.4, and 2300-220.
Approximately 0.5 mile of a closed and abandoned forest road would be reconstructed to access the floodplain and river channel. The reopened road would be treated as a temporary road and would be closed and decommissioned prior to completion of the restoration project. Use of a helicopter to transport trees to the river will reduce the amount of road reconstruction needed. The temporary road will be reconstructed, used, and closed. However, the road may potentially be used in Phase II of the project.

Map 3. Wood Source



No Action Alternative

Direct and Indirect Effects
Under the No Action Alternative, none of the approximately 115 acres of second-growth stands would be used as a wood source. The No Action Alternative would have no direct effects on stand development.

Cumulative Effects
As detailed in the descriptions of historic management activities and current stand conditions, there have been a significant amount of past vegetation management activities in the planning area. The forest stands proposed to be used as a wood source are in a dense second growth condition with little structural and compositional diversity and provide few opportunities for late-successional species. The stands would be left to develop naturally.

Proposed Action Alternative

Direct and Indirect Effects
Gap creation would directly promote the development of late-successional characteristics by: enhancing horizontal and vertical spatial diversity within the stands by creating canopy gaps; and by transferring part of the stands growth potential from the upper canopy to the forest floor within and around canopy gaps.

The indirect effects include: accelerating tree growth for the development of large trees, snags, and coarse woody debris; and allowing the increase and diversification of understory vegetation as well as introducing a second canopy layer.

Cumulative Effects
As detailed in the descriptions of historic stand management activities and current stand conditions, a significant amount of past vegetation management activities has occurred in the planning area. The proposed gap creation would promote the development of habitat characteristics that are found in fully functioning late-successional/old growth forest. The proposed action alternative would expand the acreage within the watershed overall which has received silvicultural treatment to enhance habitat characteristics and promote development of late-successional structure.

Table 11.

Unit #	Land Allocation and Subwatershed	Size (Ac)	Prescription	Acres of Gaps Created
1	AMA North Fork Skokomish	16.4	Small openings/clearings (1 – 1.5 acre), knocking trees over with excavators	2.4
3	AMA South Fork Skokomish	22.1	Small openings/clearings, knocking trees over, but avoid the wetland	3.3
4	AMA	64.4	Small openings/clearings,	9.6

	North Fork Skokomish		knocking trees over	
9	AMA North Fork Skokomish	11.8	Small openings/clearings, knocking trees over	1.8

Invasive Plants

Direct and Indirect Effects

No Action Alternative
The no-action Alternative would not change the current condition of invasive plant species in the project area.

Proposed Action Alternative
Under the proposed action, there would be ground disturbance and newly exposed soil where roads are reopened and used for accessing the units and the river channel, in the floodplain and river channel, and in the newly created forest gaps that would result from the tree removal of whole trees within the proposed units. These areas would be susceptible to invasive plant colonization, particularly since there are already invasive species documented in adjacent areas that could provide a ready seed source. The proposed revegetation of the floodplain with native tree and shrub species would contribute to reducing and preventing the spread of invasive plants within the project area by establishing plants that could successfully compete with shade intolerant weeds that may otherwise colonize the floodplain. In order to control noxious weed colonization and spread under the proposed action, prevention and weed eradication activities will be implemented before, during and after project activities. These mitigation measures are described in Chapter 2.
Since the completion of the surveys associated with this project, nearly all of the system roads associated with this project have been treated with the intent of controlling or eradicating the species of weeds. Closed roads associated with the proposed project (2300-221 road and unit access roads) have not been treated for weeds in the last 5 years, but areas where weeds have been observed on these roads are scheduled to be treated either prior to or following the completion of this project. All roads associated with the project will continue to be treated and monitored into the future as necessary. Implementation of the proposed project with mitigations would provide positive results in the prevention of invasive plant spread and treatment of current infestations.

Cumulative Effects
Many activities occurred in the past that contributed to the establishment and spread of invasive plants in and adjacent to the proposed project area. The implementation of this project will not contribute to the existing problem, and will have a positive effect on preventing the spread of invasive plants and on control or eradication of current infestations.

Recreation

The South Fork Skokomish is a popular recreation area for river enthusiasts. The Oxbow is a put-in for an expert kayak run down through the gorge. One of the issues raised in scoping comments was the potential for the in-stream structures to create safety hazards for river users. The LW structures have been designed to imitate natural log jams and complexes similar to those found in other reaches of the river. Much of the structures will be buried. No cabling will be used to stabilize the structures. No full-spanning log jams will be constructed.

The project area is within a low gradient, easy reach of river compared to the gorge section immediately downstream. Based on the design of the structures, their location primarily along river banks and bars, the wide stream channel and low gradient within the project reach, and the expert skill level of boaters who would typically be floating the gorge section, it is highly unlikely that the constructed LW structures would create a safety hazard.

If individual pieces of large wood from the structures float free and are carried downstream into the gorge they may create log jams and safety hazards in the canyon areas. Log jams and wood hazards are common in many other whitewater rivers throughout the Pacific Northwest. Expert boaters are aware of the hazards and experienced in negotiating the hazards safely. Because the structures are expected to accumulate wood by trapping pieces floating down from upstream, the structures could ultimately reduce the amount of large wood passing through the gorge section.

Climate Change

Potential Effects of Climate Change on the Hydrology

Model projections in the draft document "Climate Change, Hydrology, and Road Management on the Olympic Peninsula" (Halofsky et al. 2010), currently under development, show increased air temperatures will affect snowpack and timing of streamflow. Increased temperatures are predicted to result in more precipitation falling as rain rather than snow in the winter and earlier snowmelt. The greatest reductions in snowpack are expected for lower elevations (<3,280 feet). This will increase winter and spring streamflows and reduce summer flows. The Skokomish watershed receives most of its precipitation as rain, but also some snow in higher elevations. It is expected that warming temperatures will have a moderate impact on streamflows within Skokomish, relative to other river systems on the Olympic Peninsula.

Changes in precipitation will affect streamflow and the frequency and magnitude of flood events. It is recognized that model projections for precipitation are much more uncertain than those for temperature. Projections for seasonal precipitation changes show increases in winter precipitation and decreases in summer precipitation. Increased cool season precipitation is projected to lead to increases in runoff. Precipitation intensity is also projected to increase, with greatest increase in flood magnitude and frequency predicted in December and January.

Shifts in hydrologic processes resulting from predicted increased air temperatures and changes in precipitation will likely impact physical watershed processes in a number of ways. Increased precipitation and storm intensity could lead to increased rate and volume of water delivery to channels, increased mass wasting and debris flows, and increased sediment and wood delivery to

streams. Increased winter and spring flow volume in streams could lead to increased floodplain inundation, increased channel migration, and increased channel erosion and scour.

Management Considerations for this Project
The LW structures proposed in this project have been designed to imitate naturally occurring log jams and complexes. They will help restore a naturally functioning, complex, and resilient habitat within the treated stream reach.

Structure designs are based primarily on the predicted Q100 or the peak flood flow that would be expected to occur once every 100 years. The structures are over-designed with a factor of safety of "2" to account for unanticipated events and unusual sheer stresses or log buoyancy factors.

If the structures experience greater than Q100 flows, they would still be expected to remain stable. Higher flows would actually decrease the stress on the structures because more of the structure would be inundated and there would be less torque. Buoyant forces would of increase and some of the smaller log pieces would likely float off, but this would not result in a critical failure. A more likely scenario than structure failure would be that the bedload movement would increase with higher flows and some of the structures may be buried temporarily by streambed deposits and aggradation. This would be considered part of the natural fluvial processes.

Aquatic Conservation Strategy Consistency

Table 12. Comparison of alternatives with the Aquatic Conservation Strategy

Aquatic Conservation Strategy Objective	No Action	Proposed Action
1. Maintain and restore the distribution, diversity, and complexity of watershed- and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.	Maintains current degraded condition.	Attains Objective- Restores
2. Maintain and restore spatial and temporal complexity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.	Maintains current condition.	Not applicable to this project. Project will not affect this ACS objective.

3. Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	Maintains current degraded condition.	Attains Objective - Restores
4. Maintain and restore water quality necessary to support healthy riparian, aquatics, and wetland ecosystems. Water quality must remain with the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	Maintains current degraded condition.	Attains Objective – Restores Short term impacts during construction, however long term benefits to water quality.
5. Maintain and restore the sediment regime under which aquatic systems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	Maintains current degraded condition.	Attains Objective – Restores Short term impacts during construction, however long term benefits to sediment inputs to the treatment reach.
6. Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	Maintains current degraded conditions.	Attains Objective - Restores
7. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.	Maintains current degraded conditions.	Attains Objective - Restores
8. Maintain and restore the species composition and structural diversity of plant community in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nut-	Maintains current degraded condition.	Attains Objective – Restores Re-establishes riparian vegetation within floodplain.

rient filtering, appropriate surface erosion, bank erosion, and channel migration and to supply amounts and distribution of coarse woody debris sufficient to sustain physical complexity and stability.		
9. Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.	Maintains current degraded condition.	Attains Objective – Restores Re-establishing riparian vegetation within floodplain will improve conditions for riparian-dependent species.

Aquatic Resources

Proposed Action Alternative

Cumulative Effects

Past Projects/Activities, Type of Action, and Location:

- Levy building, road construction, land clearing, Land development, Lower watershed
- Private timber sales, Logging, Mid to lower watershed
- Past Forest Service timber sales, Logging, Upper to mid watershed
- Forest road construction, Road construction, Watershed wide
- Forest road maintenance, Road maintenance, Watershed wide
- Invasive weed abatement programs, Weed control, Watershed wide
- Brown and LeBar Creek overwintering ponds, Fisheries enhancement, Middle watershed
- Brown and LeBar Creeks in-stream structures, Fisheries enhancement, Middle watershed
- Brown and LeBar Creeks conifer release, Riparian rehabilitation, Middle watershed
- Forest road decommissioning, Upslope rehabilitation, Watershed wide
- Salmon carcass distribution, Nutrient enhancement, Upper and mid watershed
- Road related landslide rehabilitation, Upslope rehabilitation, Watershed wide

Ongoing Projects/Activities, Type of Action, and Location:

- Levy building, road construction, land clearing, Land development, Lower watershed
- Private timber sales, Logging, Mid to lower watershed
- Forest road maintenance, Road maintenance, Watershed wide
- Invasive weed abatement programs, Weed control, Watershed wide
- Forest road decommissioning, Upslope rehabilitation, Upper to mid watershed
- Salmon carcass distribution, Nutrient enhancement, Upper and mid watershed

Foreseeable Projects/Activities, Type of Action, and Location:

- Levy building, road construction, land clearing, Land development, Lower watershed

- Private timber sales, Logging, Mid to lower watershed
- Forest Service timber sales, Logging, Upper to mid watershed
- Forest road maintenance, Road maintenance, Watershed wide
- Invasive weed abatement programs, Weed control, Watershed wide
- Forest road decommissioning, Upslope rehabilitation, Watershed wide
- Salmon carcass distribution, Nutrient enhancement, Upper and mid watershed
- Fir Creek bridge installation, Fish passage, Mid watershed

Soils

Soil Productivity
Overall soil productivity in the planning area is moderately for the stands. Site index is about 108 for Douglas fir. The impacts to soil productivity associated with wood source removal activities include displacement, compaction, rutting, and nutrient loss. In most situations, preventing soil impacts is the most effective and feasible way of ensuring long-term soil productivity.

- Soil Displacement and Erosion-Soil displacement and erosion from equipment (tracked excavator only) rating is slight. Rating is primarily based on slopes (generally less than 5%) and erodibility (K) factor of the surface soil. Soils will likely be highly disturbed due to tree tipping and root system removal, but will remain on location and not be transported elsewhere. This will be confined primarily in the gap openings and new skid trails. Unit design away from streamcourses and wetlands will protect these resources from erosion and sedimentation to streams. Other project design criteria (PDC's) are described in the NEPA document that will address soil displacement and minimize impacts to soils.

- Soil Compaction and Operability Risk Ratings- from equipment (tracked excavator only) rating is moderately-suited. Factors such as coarse-textured, gentle slopes and expected dry soil conditions should help to ameliorate the impacts, confined primarily to gap openings and other equipment access locations. Based on field investigations, existing skid trails and landings are still readily apparent with little conifers and hardwoods growing on them. PDC's described further in this report will help in mitigating impacts.

Significant disturbance of the surface and portions of subsurface soils in the areas of gap openings and wood source removal is expected, due to the nature of the tree removal with root wads attached and equipment operations across the openings. It is expected that short term impacts will result but long term impacts will be ameliorated over time due to freeze/thaw and bioturbation. Transects in a few of the units and historic aerial photo interpretation indicated that primary skid trails and landings occupy about 3 to 5 percent of the activity area on average. These existing skid trails, landings and old roads will be utilized where possible to reduce the extent of additional area in compacted detrimental condition. Monitoring has shown that when designated skid trails are properly laid out and utilized in conjunction with line pulling, and limiting skid trail spacing to no closer than 110 feet apart, and other mitigations described in the Decision Memo, detrimental soil conditions result in about 10 to 15 percent of the activity area.

Cumulative Effects – Detrimental Soil Conditions
Residual compaction and other detrimental soil conditions from the original tree removal of these plantations have been considered. The existing area in a detrimental soil condition resulting from previous logging ranges from 0.15 to 0.80 percent. Table 13 displays existing and expected area in a detrimental condition. Compaction from expected ground based equipment impacts, considering use of existing skid trails and roads in a detrimental condition, ranges from 16 percent (Unit 4) to 19 percent (Unit 1). It has been assumed for this analysis that the entire area of gap openings will be disturbed either by equipment or root wad removal, along with minor new disturbance associated with access areas within 100 feet of the gaps off of existing skid trails or old road beds. Mitigations described below will ensure that this area of disturbance will remain below 20 %. This is within the Forest Plan Standards and Guidelines and Regional Soil Quality Standards.

Table 13

Unit Number	Acres	Existing Acres Detrimental Condition	Acres - ground based	Total Acres Impacted	Total % of Unit
1	16.4	0.78	2.4	3.18	19.0
3	22.1	0.75	3.3	4.05	18.0
4	64.4	0.8	9.6	10.4	16.0
9	11.8	0.15	1.8	1.95	17.0

Visual Impact

All in-stream work would be accomplished during the summer low water period (July 15 – September 15). The visual effects would be short in nature and would return to a natural setting when the structure construction is complete. Large wood debris structures are intended to mimic the natural process and will look like native in-stream features as they age. The visual effects of tree removal in the wood source areas will be longer in nature and show some ground disturbance from root wad removal. Tree removals would create a variety of small (1-1.5 acres) openings. In some cases, individual trees would be selectively removed to minimize changes in the stand canopy. One to one and half acre openings would be distributed along old road grades within units. Openings would be approximately 100 feet from system roads, and would be approximately 200 feet from one another.

Cultural

The Skokomish River Valley and the entire Hood Canal drainage were once occupied by the Twana people. The Twana were skilled hunters, gatherers, and fishermen who shared a common culture and language (Suttles and Lane 1990). Within the larger Twana group were smaller village communities that functioned as autonomous groups. During historic times, all of the Twana groups were moved together onto the Skokomish Indian Reservation and any differences between the groups were blurred.

Twana village communities functioned as independent economic, social, and political units. Elmendorf (1992) recognized nine village communities and lists them by winter village locations: Dabob, Quilcene, Dosewallips, Duckabush, Hoodsport, Skokomish, Vance Creek, Tahuya, and Duhlelap. Most of the village communities had one winter village location situated near the mouth of a salmon stream on Hood Canal, the exception to this were the Skokomish and Vance Creek groups. The Skokomish maintained at least five winter village sites in the Skokomish River Valley, but functioned together as one community. The Vance Creek group maintained only one winter village location but this was inland and they relied more heavily on land mammals than the other groups (Elmendorf 1992).

The Twana utilized a variety of resources but placed a large emphasis on salmon. Elmendorf (1992) ranks the foods in order of importance as salmon, salt-water fish, sea mammals, mollusks, waterfowl, land game, roots and berries. Use varied somewhat by location. The most important land game, were elk and deer.

Euro-American explorers came to the Pacific Northwest in the late eighteenth century. The first recorded Euro-American contact with the Twana was by Captain George Vancouver who explored Hood Canal in 1792. Vancouver named the waterway Hood's Channel. He noted the presence of Indian villages along the shoreline and visited a village near the mouth of the Skokomish River to barter.

One of Governor Steven's first jobs was to negotiate treaties with the Indian tribes so that the land could be settled. The Point-No-Point Treaty was negotiated by Isaac Stevens with the Twana, Chemakums, and Klallams on January 25, 1855. The treaty designated a reservation but did not specify a location. The Indian Agent for Puget Sound, Colonel M.T. Simmons, proposed to locate the reservation in the Upper Skokomish Valley between the North Fork and South Fork. Local settlers opposed this location because they felt that the Indians would cross their lands on the way to and from saltwater (Eells 1971). The reservation was instead located at the mouth of the Skokomish River and approved by Congress in 1859. Most of the Twana were relocated, sometimes by force, to the newly established reservation. The Klallam and Chemakum never moved to the reservation.

Many settlers moved into the region in the late 1880s through early 1900s. From the early 1890s through the first decade of the 20th century there were a number of settlers on the upper South Fork; mostly making their way overland from Lake Cushman rather than following the river up (Richert n.d. 25-27). Many of these settlers may not have lived year round on the South Fork. Economic pursuits in the area included farming, mining, and logging and the area was also well used recreationally by hunters and fishermen. Most of this land was included in the Olympic Forest Reserve in 1897 and most of the settlers were not able to prove up on their claims.

The upper South Fork was logged by the Simpson Logging Company during the first half of the 20th century. Sol Simpson formed the Simpson Logging Company in 1890 and in 1895 he and Alfred H. Anderson incorporated both the Simpson Logging Company and the Peninsular Railroad Company. Mark E. Reed joined them a few years later and when Simpson and Anderson died in 1906 and 1914 respectively, Reed was left as the manager of Simpson Logging Company, Phoenix Logging Company, the Peninsular Railroad and several other businesses.

The Simpson Logging Company was based near Matlock and Shelton and in the 1920s they extended their track and built the Skokomish River Bridge to access timber in the Olympics (Spector 1990). In the 1930s and 1940s Simpson operated several logging camps located a few miles south of the project area (Righter 1978).

No artifacts or other cultural resources were found within the Area of Potential Effects for this project and no additional work is recommended at this time. There will be no historic properties affected as a result of this project.

Clean Water Act Compliance

The proposed treatment reach of the South Fork Skokomish River is on the 303d list of temperature exceedance (WA DOE 303d list 2004). Under the action alternative maximum water temperatures would incrementally decrease as a result of stabilizing streambanks, reducing width-to-depth ratios, protecting riparian vegetation and increasing stream shade in the long term.

All project actions will follow applicable provisions of the Clean Water Act. A short-term exemption will be required from Washington Department of Ecology to exceed State water quality standards for turbidity (WAC 173-201A).

A CORPS 404 permit will be acquired for placement of instream material.

CHAPTER 4 LIST OF PREPARERS AND AGENCIES CONSULTED

Issues associated with the Proposed Action were identified by an interdisciplinary team through an extensive scoping process. This process included a review and evaluation of information gathered through specialist input, and ongoing public involvement and correspondence until a decision is determined.

A team of Olympic Forest Service employees has conducted preliminary analysis, development of a Proposed Action and subsequent action alternatives, and environmental analysis for the South Fork Skokomish LW Enhancement Project. The makeup of the team was based upon the action being proposed and the expected effects of the proposal on other resources and values. Members and contributors to this team are listed below.

IDT Members and Contributors

NAME	CONTRIBUTION
Marc McHenry	NEPA - Project Leader, Fisheries Biologist
Jeff Muehleck	NEPA – Writer / Editor
Susan Piper	Wildlife Biologist
Mark Senger	Silviculture

Cheryl Bartlett	Botanist
Scott Hagerty	Soils
Stephanie Neil	Cultural Resources
Dean Yoshina	District Ranger (Responsible Official)

Following development of the Proposed Action, scoping letters were distributed to the general public and to the following recognized Tribes, and other Federal and State agencies listed below. Any responses from these parties were considered and incorporated into: further refinement of the Proposed Action, development of action alternatives and/or analysis of environmental effects. More detailed information may be found in the South Fork Skokomish LW Enhancement Project analysis files.

Agencies and Tribes Consulted

NAME
Skokomish Tribe
NOAA Fisheries Service
U.S. Army Corps of Engineers
U.S. Fish and Wildlife Service
Washington Department of Ecology
Washington Department of Fish and Wildlife
Washington State Department of Archaeology and Historic Preservation

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